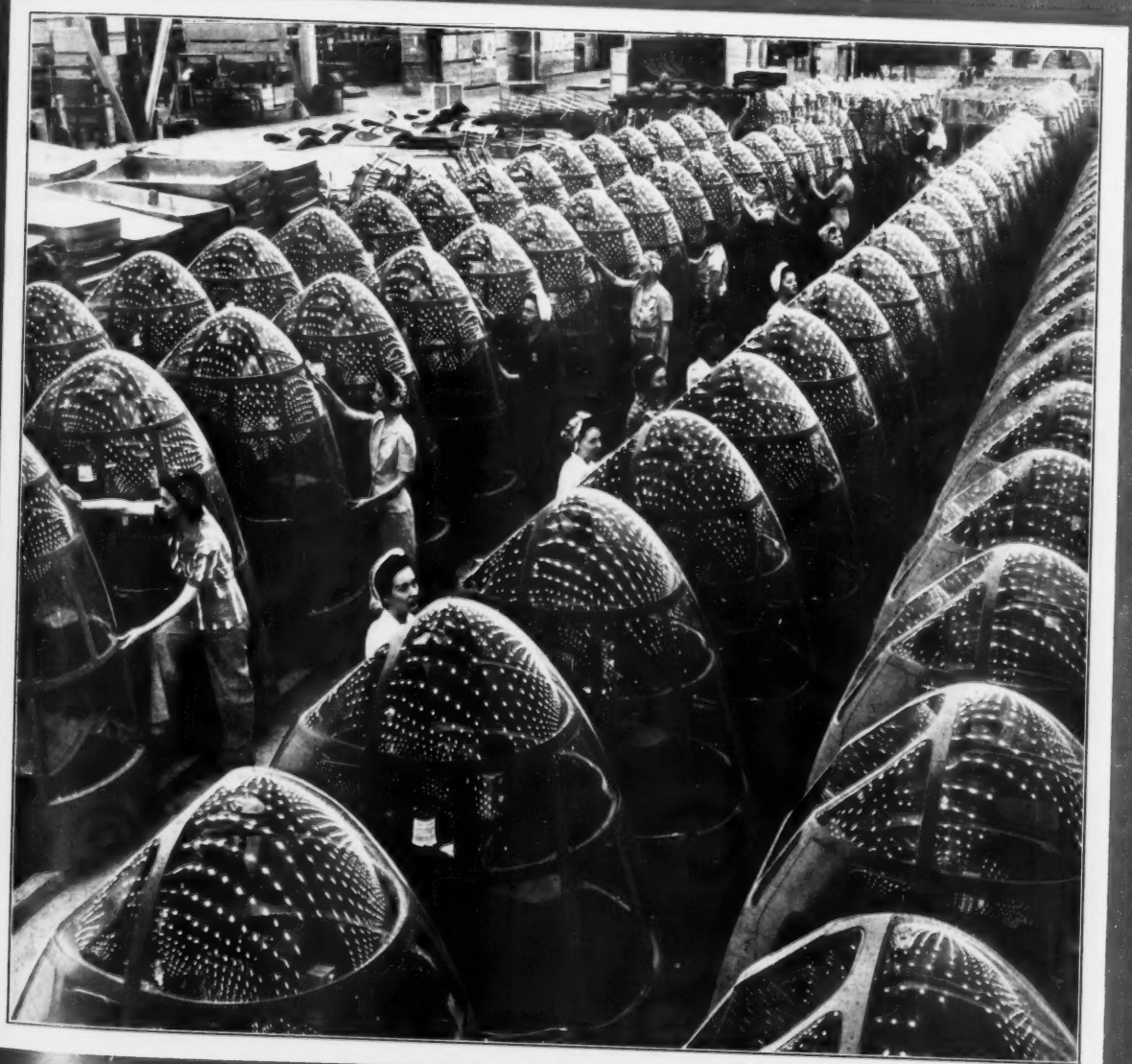
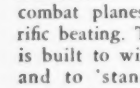
RECEIVED FEB 2 1943

AERONAUTICAL ENGINEERING REVIEW

FEBRUARY 1943



Another "slugger" off the line... complete with *Aeroprop!*



IT'S LIGHT—The Aeroprop is engineered for maximum strength without useless weight. Excess weight reduces plane efficiency.

IT'S STRONG—Propellers on combat planes take a terrific beating. The Aeroprop is built to withstand abuse and to 'stand up' under stress of combat service.

IT'S SIMPLIFIED—The Aeroprop is unit-constructed, which means that automatic pitch control, plus the power for pitch changes, are right in the compact propeller assembly itself.

One of America's finest fighting ships has earned a hard-boiled nickname—the *slugger.*

The slugger shown above is getting its Aeroprop.

You'll notice one particularly interesting fact in this production-line view of a fighter in the making. The Aeroprop is going on the ship as a single, compact unit. In a matter of minutes the complete propeller will be fully installed and ready for flight.

Thus, the Aeroprop saves installation time, but it also saves time that's even more precious. Compact unit-construction makes it possible to check and service an Aeroprop in double-quick time, and that is a big advantage at the fighting front. When the heat is on, every maintenance minute saved is a fighting minute earned.

From steel blade tip to hollow hub the Aeroprop is engineered for top combat efficiency. It is rugged, strong, light. With each passing day the Aeroprop's performance becomes an increasingly decisive factor in America's air strength—because every day more and more planes are going off the production line and onto the fighting line—*complete with Aeroprops.*

AERO PROP

AEROPRODUCTS DIVISION **GENERAL MOTORS** CORPORATION

GM ARMS FOR VICTORY

AERONAUTICAL ENGINEERING REVIEW

Published Monthly by the Institute of the Aeronautical Sciences Inc.

FEBRUARY, 1943

VOLUME 2 NUMBER 2

OFFICERS

President
Hugh L. Dryden

Past-Presidents
J. C. Hunsaker
Charles L. Lawrance
D. W. Douglas
Glenn L. Martin
Clark B. Millikan
T. P. Wright
George W. Lewis
James H. Doolittle
Frank W. Caldwell
Hall L. Hibbard

Vice-Presidents
J. L. Atwood
Ernest R. Breech
Sherman M. Fairchild
Earl D. Osborn

Executive Vice-President
Lester D. Gardner

Secretary
Robert R. Dexter

Treasurer
Elmer A. Sperry Jr.

Assistant Treasurer
George R. Forman

Controller
Joseph J. Maitan

Council
P. R. Bassett
W. A. M. Burden
Charles H. Colvin
R. T. Goodwin
L. S. Hobbs
C. S. Jones
Roger Wolfe Kahn
W. Wallace Kellett
James H. Kimball
John C. Leslie
R. D. MacCart
Arthur Nutt

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: United States and possessions, 1 year, $7.00; single copies, $0.70. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $1.00.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pennsylvania.
Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York, N. Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute. Permission is given to reprint any article after its date of publication provided proper credit is given.

CONTENTS

Cover Illustration: Rohm & Haas Plexiglas nose assemblies for Douglas attack bombers.

Articles

Progress in Aircraft Plywood, 1941–1942. . . . . Thomas D. Perry 7
Cambridge Instrument Company . . . . Richard Rick 21
Acrylics in Aviation . . . . . D. S. Frederick 25
Western Electric Contributes to Aeronautical Progress . . . . . F. C. McMullen 27

Reviews

Periodicals 29
Government Publications 81
Books 85

Aerosphere, 1942
Air Navigation for Beginners
Aeronautics Workbook
Jordanoff's Illustrated Aviation Dictionary
Parachutes
Flying Health
Principles of Aeronautical Radio Engineering
Aero Engines
The Way of a Pilot
Navigation Principles
A Start in Meteorology
Aircraft Detail Drafting
Seven-Place Values of Trigonometric Functions
Young America's Aviation Annual: 1942–1943
Radio Principles
Basic Principles of Weather Forecasting
Fighter Facts and Fallacies
Aerobiology
The Adrenal Cortex in Adaptation to Altitude, Climate and Cancer
Opportunities in the Armed Forces
Army-Navy Guide
American Diesel Engines
Camouflage Simplified
Book of Modern Warplanes
Torque Converters or Transmissions
Well's Manual of Aircraft Materials and Manufacturing Processes
Superchargers for Aviation
Bombs Away

House Organs and Catalogues 99
From the Industry 105
Eleventh Annual Meeting—Final Program 119
Institute News 123
Appreciation to Corporate Members 141
Directory of Aircraft Products and Services 143
Index to Periodicals Reviewed 151
Index to Advertisers 155

George R. Forman, *Editor* Bennett H. Horchler *Manager*

Harris F. Reeve, *Assistant to the Editor*

Associate Editors: Gail Wadro, Edward G. Ingram Berneice H. Jarck

Trail Blazing in the Skies

1931

THE LARGEST AIRCRAFT STRUCTURES ever to be built of duralumin in this country were fabricated by Goodyear. Our experience in forming duralumin sections for use in both airplanes and airships goes back to 1923. Most of the duralumin alloys that have been widely used in aircraft construction since then were first produced to meet airship specifications.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AVIATION INDUSTRY

1. *By building parts to manufacturers' specifications.*
2. *By designing parts for all types of planes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or construction problem.*

Progress in Aircraft Plywood, 1941–1942

THOMAS D. PERRY*

The Resinous Products & Chemical Company

THE PAPER on "Aircraft Plywood and Adhesives," presented before the annual meeting of the Institute of Aeronautical Sciences two years ago,† was prepared at a time when plywood was just emerging as a suitable raw material for use in some types of aircraft. However, phenomenal progress has been made in these two years, in directions that could not be foreseen. Thus it becomes desirable to present supplementary information in order to bring these earlier data up to date and to make a more complete background that will be helpful in evaluating, from present-day knowledge, the challenging opportunities for plywood in aircraft.

Government standards reflect this wider range of plywood applications. It can well be said that its specifications have been both broadened and tightened. They have been broadened in that Army-Navy-C.A.A. specifications now include cold-setting resin adhesives for assembly work, Army Air Corps specifications now provide for high-density (Compreg) plywood for propellers, and the like. The tightening of the Army-Navy-C.A.A. specifications is evidenced by the three-hour boil test for primary adhesives used in making aircraft plywood and the acidity limits for assembly or secondary adhesives. These changes have been mutually advantageous to the plywood and adhesive manufacturers, in giving them a wider market, and to the aircraft designer who has been diligently searching for acceptable alternates in order to release more critical materials for essential requirements.

Other definite Government cooperation in plywood aircraft problems is apparent at the Forest Products Laboratory, at Madison, Wis., where greatly increased emergency appropriations have permitted a distinct enlargement of the Laboratory's activities. The publication, as of July, 1942, of the *Wood Aircraft Fabrication Manual* and the *Handbook on the Design of Wood Aircraft Structures* has made available to aircraft makers the large reservoir of information and experience accumulated at the Laboratory. Both books are comprehensive and afford far more convenient reference than the many separate bulletins that preceded them.

Only the more important developments of the past two years can be outlined here, such as: improvement in resin adhesive formulations; study of pressure requirements and methods of application; methods of temperature applications, including radio frequency heat; scarf jointing of plywood, for larger than standard sheets; continuous veneer splicing equipment; and impregnation of veneers, including high-density plywood. It must be realized by the reader that these developments are still moving forward and that this paper cannot be more than a progress report, subject to further revisions as research activities broaden the plywood horizons.

Improvements in Resin Adhesives

There have been far-reaching developments in resin adhesive research in both industrial and government laboratories. These studies have included the phenol-formaldehyde group, used chiefly for primary adhesives in the making of plywood, as well as the various urea-formaldehyde resins, which find their major use in secondary or assembly gluing of wood and plywood parts.

The *phenol-formaldehyde* resin adhesives are now available not only in film form, such as Tego, for convenient interleaving between the veneer layers but also in dry powder and solution form. These dry powders can be mixed with water or alcohol or with various combinations of the two. This allows adjustment of the spread and, in addition, the use of part or all alcohol permits higher solids concentrations, thus introducing less moisture into the veneer. It is further true that alcohol reduces the tendency of the spread veneer to warp and, by surface or skin drying of the spread, renders the veneer more ductile for bending. While extensively used on flat plywood, these phenolic-alcohol combinations are found particularly adaptable in gluing monocoque shapes, molded by the flexible bag process. The storage life of the powders is excellent. Similar results can be secured with the phenolic solutions, but their storage life is definitely shorter.

Limited amounts of extenders, such as walnut shell flour, have been found practical in some of the phenolic combinations, improving certain qualities and reducing costs with but little sacrifice in durability.

The curing temperatures of phenolic resin adhesives have been reduced, both with and without catalysts. When catalysts, usually acidic in nature, are used, especial care must be exercised that the acidity of the mixture is low enough not to weaken the fiber cohesion of the wood. There is distinct danger in this factor, that has not been generally recognized by the users.

The *urea-formaldehyde* resin adhesives continue to be available in solution and powder form, and the advances in this type have been mostly those of a wider range of catalysts or hardeners for bonding without the use of hot presses. In general, in this class of resins, the usable or spreadable life of the mixtures in the pot is about half of the time required to cure a resin bond under pressure. The standard mixtures, which are usually supplied as a powder with catalyst incorporated, have a usable pot life of approximately four hours, requiring a clamping period of four to eight hours, both at 70° to 75°F. If the glue joints in the clamped bundles can be exposed to moderate heat, up to 150°F., this latter time can be substantially shortened. With the use of proper catalysts, the pot life can be reduced to one hour, with corresponding lessening in pressure-time requirements. In the case of continuous splicing machines for lumber cores or veneers, where the joint is directly exposed to substantial heat, the bonding requirements can be shortened to a few minutes. This speed gives only an initial grip that will maintain the close contact of the pieces, and the more complete cure follows gradually after delivery from the machine.

The combination dry powder form with incorporated catalyst when used for aircraft assembly should have the low acidity (pH > 2.5) required in specification AN-G-8. This combination has a wide range of utility, since it is a one-step mixture with excellent spreadable life. It is adapted not only to bench and assembly work but also to wide area gluing, as in plywood and laminated constructions. However, some of the fast catalysts referred to above may not come within this acidity range, and this factor should be recognized in aircraft work. The fact still remains, however, that, for highest quality bonds, cold bonding should only be employed in those applications

Presented at the Aircraft Production Session, Eleventh Annual Meeting, I.Ae.S., New York, January 25–29, 1943.

* Development Engineer.

† Journal of the Aeronautical Sciences, Vol. 8, No. 5, pp. 204–216, March, 1941.

IN THE AIR—
ALL OVER THE WORLD
ZAPON SX-35

Zapon's finishing system based on one material only up to the top coat, is now in use for plywood planes, gliders and wood propellers.

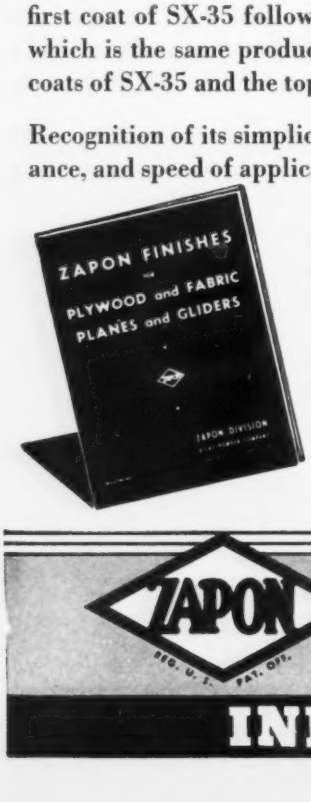
One important reason for the immediate success of this finishing system is Zapon SX-35. This product, originally designed to meet Government specifications for plywood plane sealer, has been found to exceed specification requirements and, with a minimum of material weight, provides highest moisture resistance. Hence it is the basis of Zapon's complete finishing system, eliminating the necessity of surfacers.

For close grain woods three coats of SX-35 followed by an aluminum coat or camouflage enamel constitute a complete system.

For open grain woods the finishing system includes a first coat of SX-35 followed by a filler coat, the base of which is the same product, and finally followed by two coats of SX-35 and the top coat.

Recognition of its simplicity, durability, moisture resistance, and speed of application has led to the adoption of this finish by a constantly increasing number of plywood plane builders. It will certainly help you.

A comprehensive booklet kept up to date by new data sheets will be sent on request.



ZAPON
REG. U. S. PAT. OFF.

ZAPON DIVISION · ATLAS POWDER COMPANY

Eastern Sales: Stamford, Conn. *Western Sales:* North Chicago, Ill.

INDUSTRIAL FINISHES

where it is not practical to apply heat.

Another improvement in the urea adhesive field is the so-called "superhardener," or fortified urea combination, for hot pressing. The addition of these special catalysts increases the durability of the urea and, in proper combinations, will pass boiling water tests up to about three hours. This fortified urea finds applications in certain forms of flexible bag work where the ureas may be more adaptable than the phenolics and in some types of flat plywood.

Melamine-formaldehyde combinations are beginning to appear, and are quite similar to the ureas. They have the advantages of relatively low temperature cures, but experience with their use, particularly from the standpoint of durability, has been limited. In view of their relatively high cost as compared to both phenolic and urea types and because of present limited production capacity for melamine, it would appear that any use that melamine-type resins may find in the plywood field will be in limited and specialized applications, at least for some time to come.

Since there are several manufacturers of resin adhesives and since each has a number of resin and catalyst types, it is important that prospective users consult their suppliers for the details of the adhesive characteristics of each item and ascertain the proper conditions for their application.

Pressure Requirements

With the conventional glues, such as vegetable, casein and soybean mixtures, the intensity of pressure was less important than it is with resin adhesives. In most cases the application of the glue mixture was so liberal that any inadvertent voids or inequalities were filled up and the resulting bond was considered satisfactory. In the case of resin adhesives it is essential, from both quality and cost standpoints, that the resin in the joint be as thin as possible while still giving adequate adhesion. Hence, with resin adhesives, either these inequalities must be avoided or the pressures increased to neutralize them. For example, with the above conventional glues, pressure ranges were seldom beyond 75 to 100 lbs. per sq.in., while with resin adhesives the proper standards were found to be between 150 to 250 lbs. per sq.in. These pressures apply to flat press work, where the plywood is held between flat or slightly formed rigid plates. In any event the purpose of the increase in pressure was mainly to compensate for slight differences in veneer thickness, or for possible mechanical variations in the press plates, and was only sufficient to bring the surfaces into intimate, close and continuous contact.

In the case of flexible pressure, where there is a rigid mold on one side only and a flexible bag is held against the opposite side of the plywood by fluid pressure exerted by steam, hot air or hot water, the technique becomes quite different. The basic reason for the difference is that variations in thickness will be equalized by the flexible pressure on one side. Hence, with resin adhesives, effective pressures of 50 to 100 lbs. per sq.in. are found satisfactory. The term "effective pressure" is used to emphasize the fact that some of the fluid pressure may be consumed in bending and holding the veneers to the mold, as is shown in Fig. 1. In this illustration the useful bonding pressure at "C" may be 5 to 10 lbs. (obtained during the early stage of building up the pressure), while at "A" and "B" it is nil. Hence the *effective* bonding pressure at the most unfavorable point must be over and above the *ineffective* pressure required to resist the distortion of the veneer. Consequently, with a total pressure of 75 lbs. per sq.in., the effective pressure may be only 65 to 70 lbs. The amount of this ineffective pressure will vary with the thickness of the veneer, the size and shape of the mold, and the complexity of the compound curvature, but its influence in all these regards must be recognized.

Another problem in the application of pressure is that it must be *continuous* and uniform. In the case of pneumatic or hydraulic pistons or of fluid pressure in flexible bags or tubes under automatic pressure controls, this maintenance of continuous pressure does not present difficulties. But in the case of hand clamps, screw presses and nailing strips, this maintenance of pressure requires careful manipulation. As an example, two blocks of wood, each 1 in. thick, with a fresh adhesive line between them, are pressed together in an ordinary metal screw clamp, to 200 lbs. per sq.in. Assume the original dimension between the tightened clamp jaws as 2.005 in. The wood will yield slightly under this pressure, the adhesive line will become thinner as the resin penetrates into the pores of the wood, and the wood may shrink slightly if the cure of the adhesive is accelerated by heat. As a consequence, the maintenance of 200 lbs. pressure may require a jaw distance of about 1.993 in. This is shown graphically in Fig. 2. If the jaw distance is not adjusted by tightening, the pressure may drop to approximately 50 lbs. or less, and the joint may prove to be below standard strength. Hence, any fixed clamp pressure is likely to be unreliable, and the periodic tightening of the clamps may be quite unsatisfactory, since it may not be done at the proper stage in the curing process of the resin. Dead load pressure, adequate spring pressure, or lever pressure is preferable where it can be applied. In the case of nailing strips, distinct pressure variations may occur from the manner of driving, the size of the head, the spacing of the nails, and the grip of the wood on the shank of the nail. Nailing may be necessary in cases where other pressure applications are not practicable, but its technique must be carefully controlled.

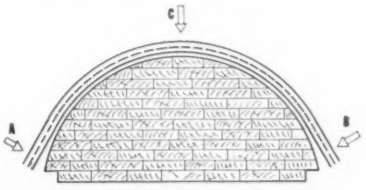


Fig. 1. Effective pressure in bag molding, showing how the low initial fluid pressure may be utilized in holding the extremities of the veneer against the mold and still be ineffective for bonding.

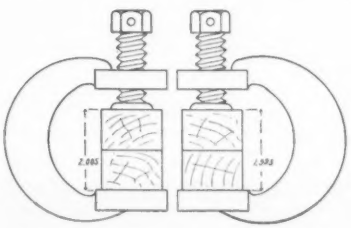
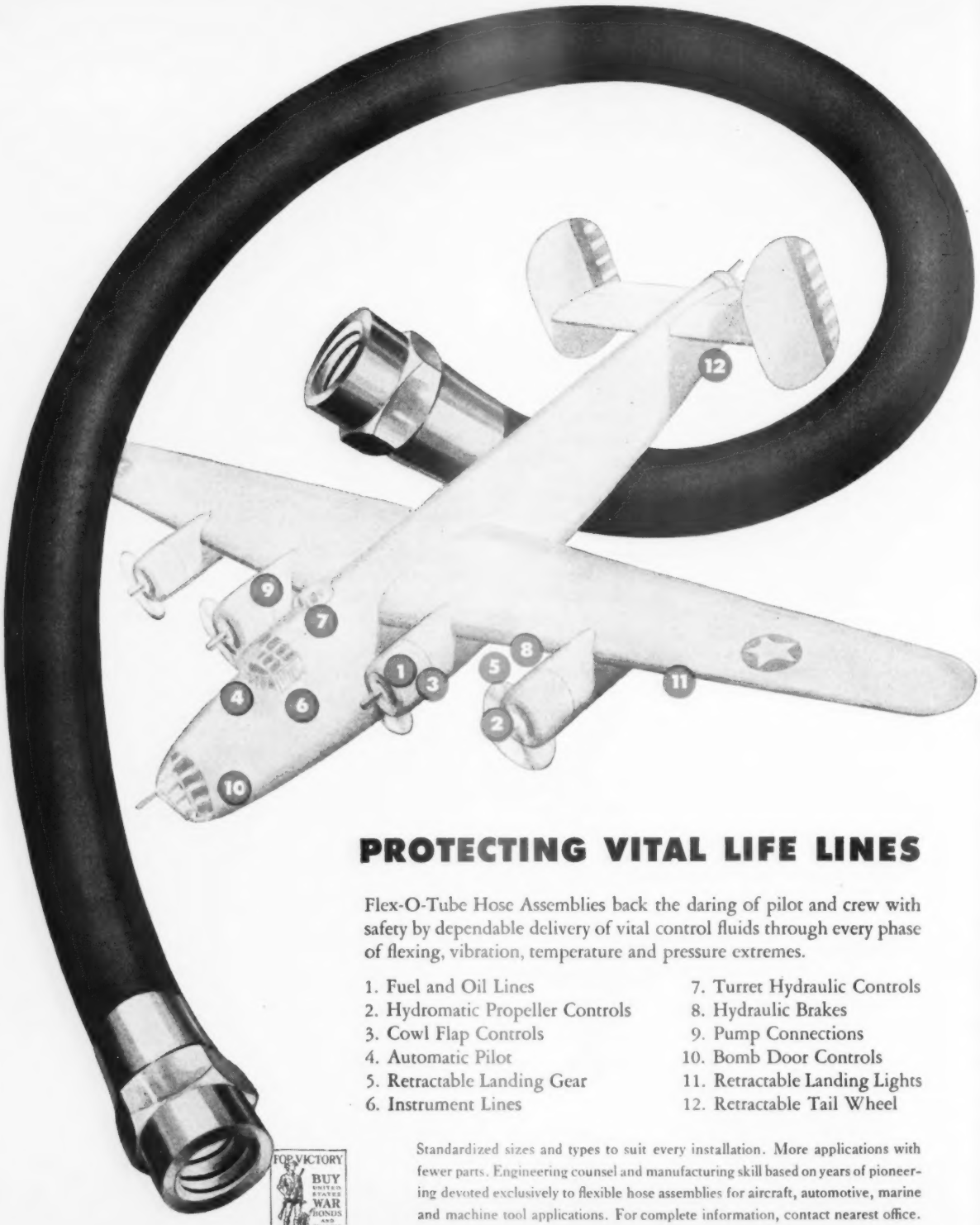


Fig. 2. Clamp pressure applications. When first clamped tight, as in the left sketch, the thickness of the glued assembly will gradually become less, reducing the pressure below adequate point for a sound bond, as indicated in the right sketch.

Temperature Applications

The conventional method of applying heat for the cure of resin adhesive bonds, has been that of *steam*, usually circulated in the flat or slightly formed platens of a hot press, as shown in Fig. 3(I). In this case the heat penetrates the plywood assembly from the upper and lower surfaces. As a consequence the exterior of the plywood is considerably hotter than the interior. When it is realized that the heat is used wholly to cure or convert the resin, it becomes apparent that this method is particularly adaptable only to relatively thin plywood, perhaps up to approximately 1 in. in thickness. Thicker assemblies will heat slowly and consequent difficulties may be encountered. However, since steam of 100 lbs. pressure is almost always available in industrial plants, this method of heating will find wide acceptance and in most instances will give satisfactory results.

A more recent method of heating wood assemblies is with *radio frequency power*, often called high frequency and quite similar in general principles to



PROTECTING VITAL LIFE LINES

Flex-O-Tube Hose Assemblies back the daring of pilot and crew with safety by dependable delivery of vital control fluids through every phase of flexing, vibration, temperature and pressure extremes.

1. Fuel and Oil Lines
2. Hydromatic Propeller Controls
3. Cowl Flap Controls
4. Automatic Pilot
5. Retractable Landing Gear
6. Instrument Lines
7. Turret Hydraulic Controls
8. Hydraulic Brakes
9. Pump Connections
10. Bomb Door Controls
11. Retractable Landing Lights
12. Retractable Tail Wheel

Standardized sizes and types to suit every installation. More applications with fewer parts. Engineering counsel and manufacturing skill based on years of pioneering devoted exclusively to flexible hose assemblies for aircraft, automotive, marine and machine tool applications. For complete information, contact nearest office.

★ *the* **FLEX-O-TUBE** *Company*

Lafayette at 14th Ave., Detroit
501 Fifth Avenue, New York
215 West 7th St., Los Angeles
67 Yonge St., Toronto, Ont., Can.

the diathermy apparatus employed by physicians. With this equipment, one type of which is shown in Fig. 3(II), the wood or veneer assemblies are placed between insulated, "G," electrodes, "D" and "D′," and these electrodes are connected to the two terminals, "E" and "F," of a short-wave high-frequency generator. This generator is of the order of the equipment used in a radio broadcasting station. The advantage of this method in the cure of resin adhesives is the fact that all portions of the wood assembly within the electrostatic fields, "H," are raised to the same temperature almost simultaneously, and the heat uniformly permeates the entire assembly. The difficulties of the surface application of steam heat and its slow penetration toward the interior are eliminated. The rate of heat increase throughout the assembly will depend on its bulk—i.e., when the bulk is doubled, the degrees of temperature increase per minute will be approximately cut in half. The rate of heat increase can, of course, be maintained by doubling the power input. This process is therefore especially adapted to thick assemblies that are difficult to heat in any other way. How far it may be adapted to thin plywood with economy in comparison with steam-heated platens has not yet been determined.

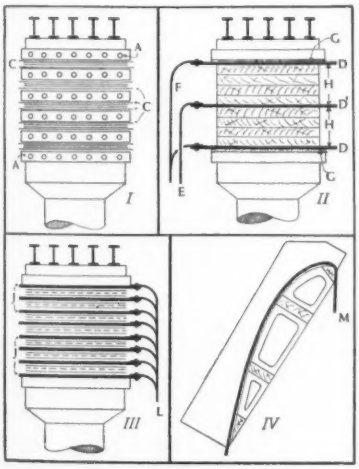


FIG. 3. Methods of heat applications.
(I) Conventional hot platen press.
(A) Steam-heated platens.
(C) Aluminum cauls.
(II) Wood assemblies, heated between high-frequency electrodes.
(D, D′) Electrodes, establishing electrostatic fields, H.
(E, F) Wire connections from transformer to fields, H.
(G) Insulating pads.
(H) High-frequency fields, containing wood assemblies.
(III) Conventional plywood press, without hot platens.
(J) Electrical resistance plates, used as cauls.
(L) Standard electrical connections.
(IV) Pressure jig for assembly work.
(M) Strip heater, to cure resin adhesive between skin covering and rib.

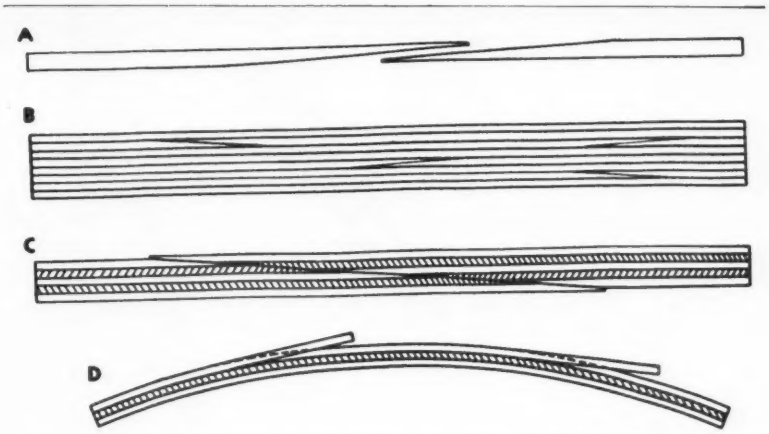


FIG. 4. Types of standard scarfed joints: (A) shape of the scarf; (B) laminated spar construction, with scarfs; (C) scarf joint in flat plywood; (D) half-scarf joint in molded (curved) plywood.

Still a third method of applying heat in the cure of resin adhesives is that of *electric resistance plates*, with heating units installed therein, similar to those in electric flatirons. This heat can be obtained from ordinary electric current sources and is thus easily available. One method of applying this process to flat plywood is shown in Fig. 3(III), where the resistance plates are used in plywood manufacture instead of the usual aluminum cauls. Such resistance plates can be used in many types of presses and clamps where the distance of required heat penetration is not so great as to char the wood.

These resistance plates are also made in the form of strip heaters and can be employed on moderately curved surfaces, as shown in Fig. 3(IV). In this instance the cure of the resin is for an assembly operation, a skin covering of plywood to a fabricated rib and spar. This heat application permits the use of a heat reactive resin of the phenolic type, although it can also be used to accelerate the cure of a urea adhesive of the cold-setting type. Phenolics are characterized by a better durability than the ureas and are more desirable to use where conditions permit.

SCARF JOINTING OF PLYWOOD

Standard plywood sizes are generally limited to 4 by 8 ft., although some hot presses are available up to 6 by 12 ft., at considerably higher cost per sq.ft. Another limitation is veneer cutting equipment, which in lathes seldom exceeds 8 ft. lengths, and in slicers does not extend beyond 16 ft. When larger sizes of plywood are required the sheets must be butted or spliced together. The butt-jointing operation increases the weight and bulk of the splice and results in extra thickness at the joint, which is often objectionable. Hence, scarf jointing, without increase of thickness and with the maintenance of upward of 80 per cent of the normal strength, becomes a useful technique.

A general rule in scarf jointing to maintain maximum strength is that the length of the scarf must be approximately 12 to 16 times the thickness of the scarfed members. It is also important that the "toe" (thin end) of the scarf be slightly blunt rather than feathered out, and be so placed in the scarf-bonding operation that it "rides" slightly ($^1/_{32}$ to $^1/_{64}$ in.) over the "heel" (thick end). In this way a strong sound bond is insured at the extremities of the scarf. Another essential factor in scarf jointing is that the scarf be cut true and be well fitted for close contact all along the joint. The quality of the resin adhesives used in the scarf joint should be equal to that used in the plywood—i.e., in aircraft plywood, phenolic resin adhesives should be employed and set under heat.

Scarf joints may be made in the single layers of veneer, as illustrated in Fig. 4, "A" and "B," for a spar, or in the completed plywood as shown in Fig. 4, "C." Where practicable, the former is desirable, since the joints can be staggered in position in the plywood. Another process of half scarfing for curved and molded plywood is shown in Fig. 4, "D," where the protruding veneer is sanded off after the completion of the bonding operation.

In bonding the scarf, in flat plywood, it is important that each overlapping member be firmly clamped in position before pressing together the tapered scarfs. A suggestive diagram of equipment for such work is found in Fig. 5, where the use of a heat-reactive phenol-formaldehyde resin adhesive is contemplated.

A further problem occurs in scarf-jointing plywood that is to be bent or curved. It is obvious that undue stresses, like those of bending, should

Call it Lightning!

– SAY THE PILOTS

NOBODY had time to name this Lockheed fighter plane when it was born. They just called it by a number, P-38.

Then the pilots sent it climbing over eight miles straight toward the stratosphere, up where even the highest-flying bombers couldn't go. They brought it screaming down out of the clouds like forked vengeance. They jammed down the throttle and it flew faster than any fighter ever flew before. They pressed the trigger-button and saw how *concentrated* fire-power from its cannons and machine guns could rip apart anything on wings—and there was only one name for it: *Lightning.*

So that's its name, a name it earned from British and American pilots alike, a name to watch: Lockheed *Lightning.* Lockheed Aircraft Corporation . . . Vega Aircraft Corporation . . . Burbank, California.

for protection today, and progress tomorrow, look to

Lockheed

FOR LEADERSHIP

Member Aircraft War Production Council, Inc.

Copyright, 1943, Lockheed Aircraft Corporation

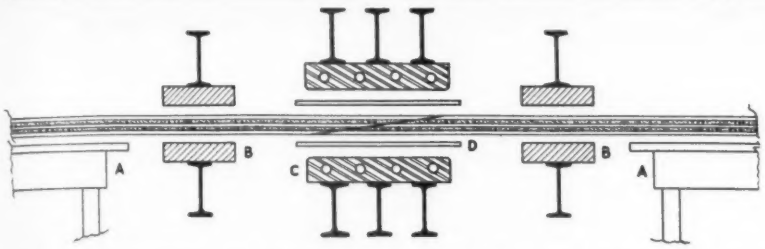


FIG. 5. Diagrammatic cross section of scarfing press: (A) tables to support plywood sheets; (B) clamps to hold plywood in alignment; (C) hot plates to apply bonding pressure; (D) aluminum cauls to avoid edge depressions.

not be imposed continuously along a scarf joint if it can be avoided. Hence, several methods of assembling scarf-jointed plywood sheets are illustrated in Fig. 6. Other similar methods can be developed for angling scarfs which will utilize, economically, the normal rectangular sheets. In such assembled sheets, the final trimming and sanding should be deferred until after the scarf joint is completed.

CONTINUOUS VENEER SPLICING EQUIPMENT

Under existing standards and specifications there is an alarming shortage of veneer suitable for aircraft plywood. The situation could be much improved if the use of narrow strips were permitted both to utilize the accumulation of narrow pieces of suitable grade and to clip out and splice together many wider pieces with removable minor defects. The conventional methods of splicing such edge joints with gummed paper tape is not permissible in interior layers, and its use on outer surfaces requires the removal of the imbedded tape after bonding and without sanding, which is a troublesome operation. Perforated paper tape or fabric tape is sometimes allowed on the inner layers, but this method is far from satisfactory.

The rapid and successful development of the continuous veneer joiner or splicer, often called the "tapeless splicer," offers a practical remedy for this situation. This machine can be used to glue thin sheets of veneer together, edge to edge, without the use of a gummed tape, at speeds and costs that are at least as favorable as the conventional taping machine. A diagrammatic section of the fundamentals of this veneer joining operation is shown in Fig. 7. The resulting glue joints, when properly made, will be as strong as the veneer and can be made with a heat-reactive resin. Hence, there are excellent arguments in favor of considering such spliced sheets as the equivalent of one-piece stock. Some competent authorities consider that the function of a taped or tapeless veneer edge splice is wholly that of holding the veneer strips in close alignment until the plywood assembly is completed and the bond is cured. It is further claimed that the holding or gripping power of the edge joint in the bonded veneer layer can add little, if any, to the ultimate strength of any plywood assembly. The wide surface joints between the veneer layers are the recognized source of plywood strength, rather than any possible bonding effects of the edge veneers. So far as known, no reliable series of tests have been made to determine the relative strength values between plywood made of one-piece veneers as contrasted with that made with multi-piece tapeless joined veneers. With the threatened shortage of high-grade veneer, this presents a promising opportunity to increase the percentage of veneer utilization.

IMPREGNATION OF VENEERS

There have been distinct advances in this field and the terms "Impreg" (impregnated wood) and "Compreg" (compressed and impregnated wood) have gained recognition, along with the more general term "high density plywood." Careful study has revealed that the impregnating resins, usually of the phenol-formaldehyde type, must be of small molecular size—i.e., taken off in an early stage of the condensation process so as to penetrate thoroughly and permeate the minute openings in the spongy cell walls or enclosures of the wood cells. Either water or alcohol solutions of the phenolic resins can be used for impregnating applications, and there are proponents of both types. The adhesive resins, products of a more

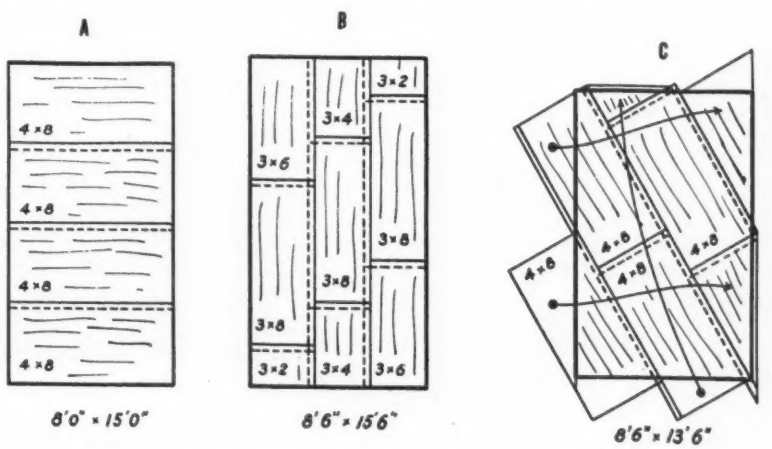


FIG. 6. Arrangements of scarf-bonded sheets: (A) joints in one direction only; (B) joints in both directions, staggered; (C) angle joints for plywood to be bent.

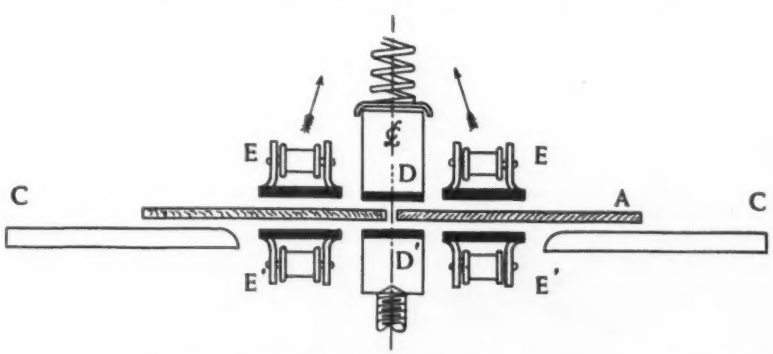


FIG. 7. Continuous veneer splicer. Diagrammatic cross section of pressure-heat devices; parts separated to show details. (A) Sheets of veneer to be spliced. (C–C) Table to keep veneer at working level of conveyer chains. (E–E) Conveyer chains, between which veneer is carried forward. These chains converge toward the delivery end to hold veneer edges firmly together. (D–D) Heating plates, electric heated, between which veneer is passed to cure the resin.

Only One Objective-VICTORY!

WITTEK *Aviation* Hose Clamps

Help to Keep 'em Flying

Since the beginning of modern aviation Wittek has been a producer of hose clamps for that industry. Today—Wittek Aviation Hose Clamps, known as the standard of the industry for dependable hose connections, are being used by the outstanding military aircraft and engine builders. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago.

. . Buy War Bonds . .

WITTEK *Aviation* **HOSE CLAMPS**

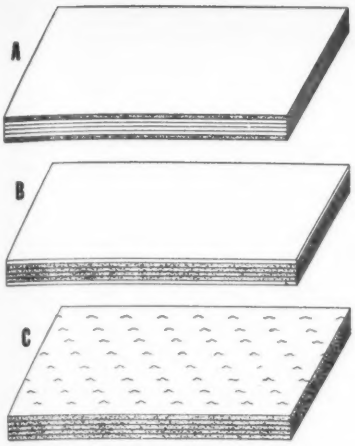


FIG. 8. Combination assemblies of low and high density: (A) outer layers of high-density veneer; (B) inner layers of high-density veneer; (C) all layers of high density, with interlocking surface.

advanced stage of condensation, are not generally suitable for high ratios of impregnation; hence, in most cases, it is desirable to impregnate the sheets of veneer with one type and to cause the sheets to adhere to each other with a different type of resin. The resin impregnation developments thus far have been largely limited to sheets of veneer not more than $^1/_8$ in. thick.

There are several objectives to be gained in the impregnation of veneer and plywood—namely, that of densification of any species to any desired extent, of strength increment, of compressibility, and of dimensional stability under conditions of severe exposure.

Impregnation is secured by immersing the sheets of veneer in solutions of the impregnating resins. If this soaking is done at normal atmospheric pressure, the veneer should be steamed to maximum moisture content and soaked for a matter of hours, sometimes as long as a day. Often, a subsequent period for the diffusion of the impregnate deeper into the wood is found necessary before drying out the impregnating solvent. If this soaking can be done under a vacuum-pressure or a pressure process, the time can be shortened to several cycles of approximately 20 min. each, a cycle being 10 min. under 50 lbs. pressure and 10 min. at atmospheric pressure. After impregnation by any of the above methods, the saturated veneers should be dried to avoid blisters from the heat of resin cure. Tests appear to indicate that a resin pickup of 25 to 30 per cent gives the optimum results. Pickup can be defined as the percentage of increased weight in the dry, cured and impregnated block over the original dry weight of the veneer.

The resin in such impregnated veneer can be cured without pressure, or with a normal pressure of 150 to 250 lbs., or made into compressed products at pressures of from 500 to 3,000 lbs. When such veneers are to be assembled into plywood, it is advisable, although not always necessary, to use a supplementary adhesive to bind the layers together. Both the impregnating and adhesive resins can be cured in a single heat exposure.

The arrangement of impregnated and unimpregnated veneer layers may be varied both as to grain direction and as to sequence. The greatest stiffness will be secured by placing the layers with parallel grain; in fact, the alternating grain directions of normal plywood have not been found to be particularly advantageous in the more highly compressed products.

Since the impregnation adds distinct weight to the veneers, it is possible to secure surface density, without too much sacrifice of lightness, by assembling impregnated outer veneers and normal untreated inner veneers, as shown in Fig. 8, "B." These high-density outer layers will take the place of the usual sealers, undercoaters, etc. Usually the total finished weight with densified surface veneer foundation will be less than normal undensified plywood finished by the conventional procedure. Another assembly combination, where it is desirable to preserve a gluable surface and still obtain the qualities of the impregnated and compressed veneers, is shown in Fig. 8, "A," where the outer layers are normal untreated veneers and the inner layers are fully impregnated. While such normal surface veneers may be somewhat compressed at first, they will tend to return to normal conditions by slight wetting after pressure release. They will present surfaces on which glue joints can readily be made. Still a third type of assembly, in which all layers are impregnated and compressed, is shown in Fig. 8, "C." Here one or both sides of the high-density sheet may be pressed, during the heat-pressure cycle, against a plate having a pattern of slight depressions. These depressions will produce small humps or knobs on the resulting high-density plywood. When used as an anchor plate against a spruce spar, these knobs can be forced into the softer spruce by the pull of the bolts, and a superior mechanical lock will result. Such mechanical locking surfaces can be as large as necessary to transmit the required loading.

If a variable density piece is desired, the successive layers of veneer can be progressively shortened, as shown in Fig. 9. When such an assembly is pressed to a uniform thickness, the density will be greatest at the thicker original section where the impregnated wood is most highly compressed, as can be noted in the lower part of the illustrations. Such higher density sections can be located as desired. This construction is under serious consideration for large propellers and is said to be extensively used in England.

PAPER PLASTICS

During the last few months considerable interest has been evident in the so-called "paper plastic." While not strictly within the plywood field, it has a definite collateral interest for aircraft construction. The product appears to have two outstanding features, viz.: (1) extremely high tensile strength (30,000 to 50,000 lbs. per sq.in.) can be obtained; (2) the process of manufacture is relatively simple, and the paper stock is freely available. It is anticipated that it will be found practical to manufacture the product on plywood presses—i.e., with pressures of approximately 200 lbs. per sq.in., as contrasted with the 1,000 to 2,000 lbs. per sq.in. normally employed in the laminating industry.

Much work on this development has been done at the Forest Products Laboratory, and the work still continues.

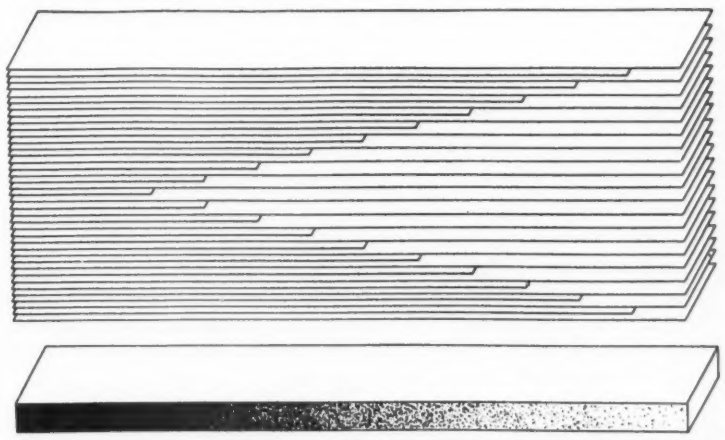


FIG. 9. Variable density, before and after pressing. Upper: Alternate progressive shortening of layers. Lower: After pressing to uniform thickness.

Conclusions

The place accorded plywood in the aircraft program has been markedly enlarged in the last two years. Military and naval *training planes* of various types are being manufactured by factories that formerly made Cub and small private planes. Wing coverings and control surfaces in these types are plywood on plywood and wood framework. Fuselages have substantial portions of plywood. In the *glider* program, glider trainers are frequently engineless private planes; cargo gliders with their wide wing spread are predominantly plywood, mostly curved and fitted from flat plywood sheets; troop carrying gliders follow the same structural characteristics. The *cargo* planes, with engines, have major portions of plywood, utilizing metals for the more heavily stressed members. In the *combat* field, fighters, scouts, bombers and torpedo planes reveal a growing number of plywood members, such as doors, seats, floors, flaps, rudders, control surfaces, etc.

Molded plywood by the flexible bag process is finding wide use in compound curved and monocoque shapes where flat plywood is wholly inadequate. More than 25 factories now have such molding equipment. The demand for flat-plywood is taxing the capacity of nearly 100 factories. High-density and impregnated plywood are both finding growing recognition where hardness and strength are predominant. The use of radio frequency power for converting resin adhesives is extending rapidly.

A candid appraisal of the situation indicates the definite adoption of plywood where strength/weight factors and workability are dominant, of metals where extreme strength is needed, of fabrics and of molded plastics where these materials may be found adequate.

Bibliography

(*See* Journal of the Aeronautical Sciences, Vol. 8, No. 5, p. 216, March, 1941.)

Government Publications

Specifications (obtainable from address shown):

Army-Navy-C.A.A. (Bureau of Aeronautics, Navy Dept., Washington, D.C.).

An-G-8; *Cold Setting Resin Glue*, April, 1942.

An-NN-P-511a; *Flat Aircraft Plywood*, April, 1942.

An-W-3; *Determination of Moisture Content of Wood*, April, 1942.

An-W-4; *Determination of Specific Gravity of Wood*, April, 1942.

Army Air Forces (Wright Field, Dayton, O.).

14,114; Application of Cold Setting Resin Glue, June, 1942.

15,065; Impregnated Compressed Wood, June, 1942.

29,538; Propeller Blank, Compressed Wood, June, 1942.

These Specifications Are Subject to Revision, and Only Latest Editions Should Be Consulted

Manuals (obtainable from Forest Products Laboratory, Madison, Wis.):

Wood Aircraft Fabrication Manual (Restricted), 1942.

Design of Wood Aircraft Structures (Restricted), 1942.

These Manuals Are Recognized by the Army, Navy and Civil Aeronautics Administration

Books

Wood and Linn, *Plywood;* W. & A. K. Johnston, Ltd., Edinburgh, Scotland, 1942.

Perry, Thomas D., *Modern Plywood;* Pitman Publishing Company, New York, N.Y., 1942.

Tiemann, Harry D., *Wood Technology;* Pitman Publishing Company, New York, N.Y., 1942.

Norris, Charles B., *Technique of Plywood;* I. F. Laucks, Inc., Seattle, Wash., 1942.

Periodical References

Resin Adhesives

Brouse, Don, *Serviceability of Glue Joints and Exposure Tests on Plywood*, Mechanical Engineering, Vol. 60, pp. 306–308, April, 1938; pp. 852–856, November, 1938.

Bigelow, M. H., *Urea Resin Adhesives*, Modern Plastics, Vol. 18, pp. 44, 94, 96, January, 1941.

Klein, Louis, *Phenolic Resins for Plywood*, Industrial & Engineering Chemistry, Vol. 33, pp. 975–980, August 1, 1941.

Campbell, W. G., *Chemical Factors Involved with Cold-Setting Urea-Formaldehyde Resin Adhesives*, Chemistry & Industry, Vol. 61, pp. 161–162, April 4, 1942.

Dietz and Grinsfelder, *Behavior of Plywood Under Repeated Stresses*, paper presented at the A.S.M.E. Meeting, Rochester, N.Y., October 12, 1942.

Pressure-Heat Equipment

Perry and Bretl, *Hot Pressing Technique for Plywood*, Trans. A.S.M.E., Vol. 60, pp. 59–68, January, 1938 (WDI-60-3); pp. 682–685, November, 1938.

Berkness, I. R., *High Frequency Methods for Gluing Wood*, Canadian Woodworker, Vol. 40, pp. 9–10, 24, August, 1940.

Rider, Keith, *Structural Applications of Plywood*, Aero Digest, Vol. 38, pp. 144, 146, 148, June, 1941.

Hawthorne, Randolph, *Molding the Langley Airplane*, Aviation, Vol. 40, pp. 75–76, 154, 156, November, 1941.

Gassner, A. A., *Resin-Bonded Wood Laminates for Shell Type Aircraft Structures*, Journal of the Aeronautical Sciences, Vol. 9, pp. 161–171, March, 1942.

Miller, E. E., *Vidal Process for Molded Structures*, Aviation, Vol. 42, pp. 124–127, 299, October, 1942.

Barnes, John S., *Making Plywood by Multi-Directional Pressure*, paper presented at the A.S.M.E. Meeting, Rochester, N.Y., October 12, 1942.

Taylor, John P., *Heating Wood with Radio Frequency Power*, paper presented at the A.S.M.E. Meeting, Rochester, N.Y., October 12, 1942.

Scarfing and Splicing

Perry, Thomas D., *Scarf Joints in Plywood*, Modern Plastics, Vol. 20, pp. 74–75, 116, 118, 120, September, 1942.

VonMaltitz and Bolling, *Edge Gluing Lumber and Veneers*, Trans. A.S.M.E., Vol. 64, pp. 387–392, May, 1942 (WDI-64-4).

High-Density Plywood

Tiltman and Ellison, *New Structural Materials*, Aircraft Production (London), Vol. 1, pp. 52–58, December, 1938.

Stamm and Seborg, *Resin Treated Plywood*, Industrial & Engineering Chemistry, Vol. 31, pp. 897–902, July, 1939.

Bernard, Perry, and Stern, *Super Pressed Plywood*, Mechanical Engineering, Vol. 62, pp. 189–195, March, 1940; pp. 748–751, October, 1940.

Decat, Robert, *Molding Plastics*, Aviation, Vol. 40, pp. 41, 126, 128, May, 1941.

Brierly, W., *Rotol Jablo Wood Airscrew Blades*, Aeroplane (London), Vol. 61, pp. 704–705, December 26, 1941; Vol. 62, pp. 14–15, 21, February 2, 1942.

Perry, Thomas D., *High Density Plywood*, Modern Plastics, Vol. 19, pp. 61–63, 110, 112, 114, May, 1942.

Finlayson, Malcolm, *High Density Plywood*, paper presented at the A.S.M.E. Meeting, Rochester, N.Y., October 12, 1942.

General

Parsons, George B., *Strength Characteristics of Resin Bonded Plywood.* Modern Plastics, Vol. 19, pp. 74–79, 110, 112, 114, August, 1942.

Schlatter, D. H., *Development of Our Army Glider Forces*, Aero Digest, Vol. 41, pp. 101–105, September, 1942.

The B.F.Goodrich Airplane of the month

REPUBLIC P-47

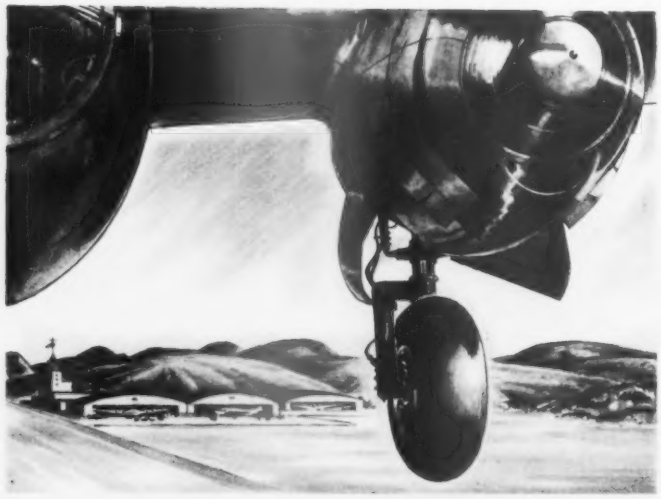
Don't be fooled by armchair strategists who talk about the superiority of other nations' fighter planes. Answer their comments with *the facts* about Republic Aviation's P-47. The "Thunderbolt," as it is appropriately known, has an effective ceiling of 40,000 feet, a super-charged 2,000 h.p. motor, unmatched speed and fire-power. No wonder the United Nations consider this Republic ship to be their ace-in-the-hole. Leading aircraft manufacturers are stepping up plane performance with the help of B. F. Goodrich Silvertown Tires, Expander Tube Brakes, De-Icers and Feed Shoes. This month, B. F. Goodrich nominates the Republic P-47 as Plane-of-the-Month.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*



Study of radial tire-growth as caused by centrifugal force!

IT HAS LONG BEEN KNOWN that tires tend to grow in radius as a result of centrifugal force, affecting the amount of clearance needed between a tire and its landing-gear strut. Today's faster-landing aircraft made this fact of greater importance to designers and builders of planes.

Mathematically, centrifugal force is known to vary directly with the square of the speed. Thus when speed is doubled—say from 20 to 40 mph—centrifugal force increases four times.

To measure the growth of a tire in inches, B. F. Goodrich engineers used a tire-testing machine, in which the road wheel, simulating movement of the ground beneath wheels during take-off and landing, was rotated at a speed of 140 mph. The tires measured were put on the swinging arm and brought into contact with the spinning road wheel.

A telescopic sight with a hair-line rule was focused at a fixed point on the tire's circumference so that any growth in the tire's radius could be accurately measured. The speed of the road wheel was varied from 140 mph down to 0 mph. Several sizes of tires were tested at these speeds.

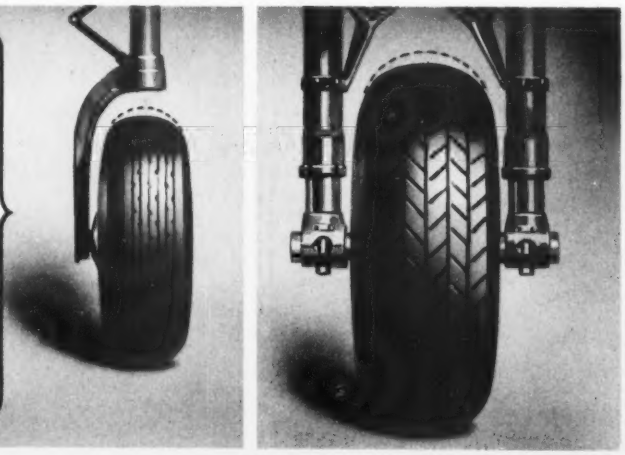
Our engineers discovered that tire-growth varied only with the speed and *very little with the size of the tire tested.* In other words, at the same speed, a 30-inch and a 56-inch smooth contour tire grow about the same amount. The graph at the right makes this point clear.

Facts gained this way are of material help in designing landing gear as well as tires that will afford maximum safety for modern aircraft. The B.F.Goodrich, Co., Akron, Ohio.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

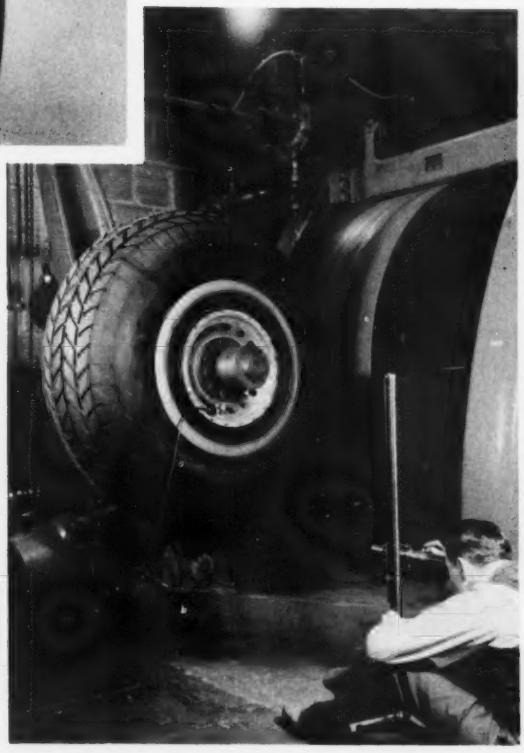
Test developed to measure radial growth

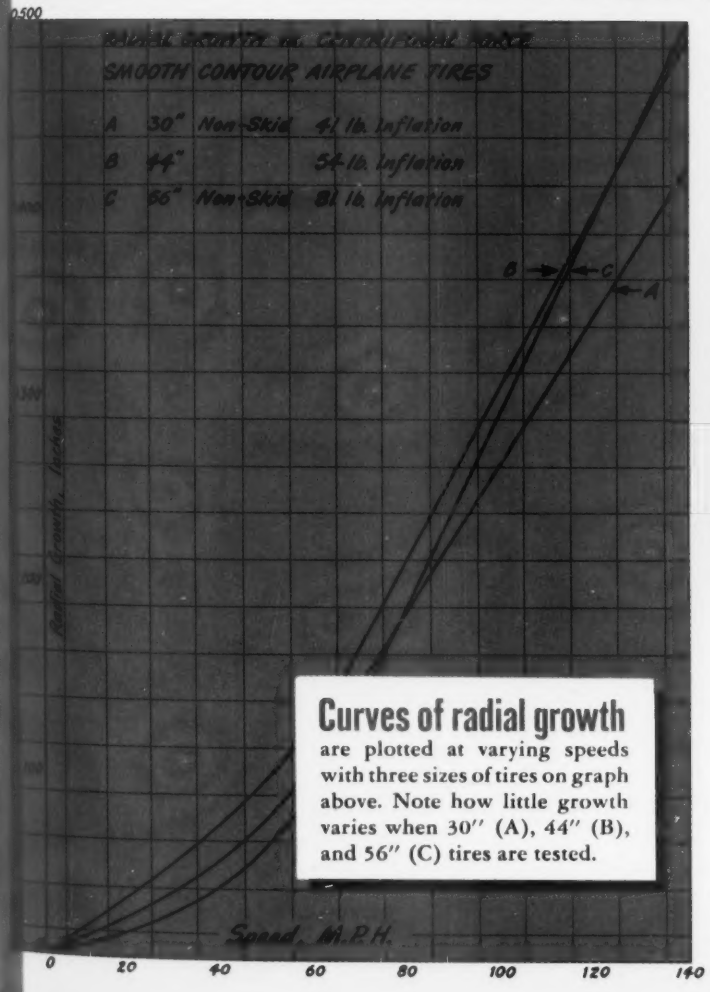
WHILE TIRES ARE IN MOTION!



Clearance of a tire in the offset and fork type of landing gear strut is reduced when tire radius grows due to centrifugal force. (Exaggeration of growth indicated by dotted line.) This has important bearing on landing gear design.

Sighting telescope on rotating tire to measure its radial growth. Hair-line rules on telescope lens permit accurate measurement in fractional inches. B. F. Goodrich Brake Tester was used to simulate action of tires during take-off and landing. Road wheel rotates at controllable speeds up to 150 miles per hour.





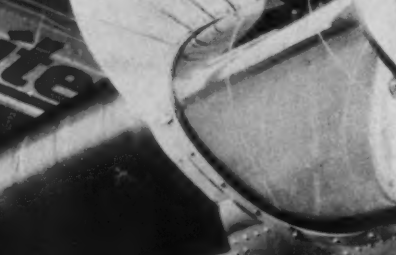
Curves of radial growth are plotted at varying speeds with three sizes of tires on graph above. Note how little growth varies when 30" (A), 44" (B), and 56" (C) tires are tested.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

DE-ICERS



CRASH PADS

RIVNUTS

PROPELLER FEED SHOE

FUEL CELLS

TIRES

DE-ICERS THAT DEFY TH ELEMENTS—B.F.Goodrich has pioneered in the devel opment of rubber De-Icers which protect the leadin edges from ice. Most mil tary and commercial a craft today are equippe with these De-Icers to pe mit flying in all sorts o weather.

★

CRASH PADS—Anothe adaptation of B. F. Goodric molded sponge rubber illustrated here. The cush ioning effect of the cras pad protects the instrume panel. Again, the benefits extra light weight, in creased cushioning and e tra strength play an impo tant part in added safe and long life.

★

PROPELLER FEED SH—Propellers, too, are pr tected from ice with th B. F. Goodrich device th feeds the propeller blad with anti-freeze fluids.

★

RIVNUTS—This hollo threaded rivet can be i stalled and headed, or u set, while working entir from one side. Develop for attaching De-Icers, i adaptable to other aeron tical uses.

★

FUEL CELLS—The il tration shows one of ma B. F. Goodrich Bullet Se ing Fuel Cells for milit planes.

★

TIRES—For largest bo ers or fastest pursuits, B Goodrich *Airplane* Sil town tires and tubes engineered for the job.

B. F. GOODRICH ★ AERONAUTICAL DIVISION ★ AKRON,

Cambridge Instrument Company

RICHARD RICK

MILLIONS of gallons of aviation gasoline have been saved by pilots using the Cambridge Aero-Mixture Indicator. A few years ago, Cambridge pioneered the method of determining the precombustion air-fuel ratio of mixtures burned in internal combustion engines by measuring the thermal conductivity of the exhaust gases. It was essentially a laboratory method then, but Cambridge engineered it to a point where application became practical and of great value in automotive engine design. To a great extent the improvement in fuel distribution in automobile engines can be attributed to use of this development. Later, the company made available a portable exhaust gas tester for routine testing and setting of carburetors in vehicles either in the shop or on the road.

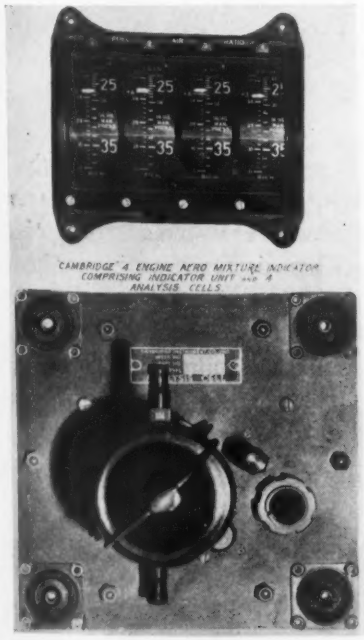
In aviation, only a short time past, fixed-pitch propellers were the standard. Pilots used the tachometer as a guide for adjusting the fuel-air mixture controls. To be on the safe side, carburetor settings were excessively rich and useless burning of fuel was given little or no consideration. For good thermal efficiency, inches could be cut from the throttle rod.

This order of things changed with the advent of the variable-pitch constant-speed propellor. An accurate and dependable fuel-air mixture indicator then became a necessity. Research in gas analyses provided Cambridge with a running start into the solution of the problem faced by aviation. On request of the Wright Aeronautical Corporation, Cambridge set to work and soon made available the Aero-Mixture Indicator, a flight instrument that has since influenced the design of carburetors and engines. Regardless of any given conditions, this aircraft instrument provides the pilot with continuous indication of the fuel-air ratio, thus enabling him to obtain optimum performance of engines and making possible greater pay load, cruising radius and safety. Output of this instrument has been multiplied impressively, and Cambridge projected the basic idea still further by making available a precision exhaust gas tester for test-stand application on internal combustion engines used in aircraft, tanks, motor vehicles and ships. Engine builders quickly recognized the value of the test-stand unit, and many now use this convenient means to make distribution tests and to determine the efficiency with which fuel is being burned in any or all cylinders of an engine under test.

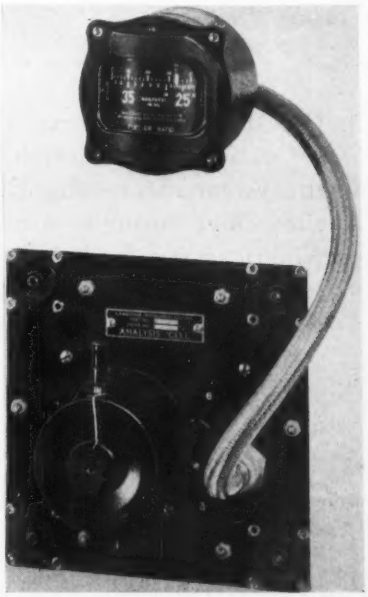
Notable development work on instruments for service in many diversified fields is routine at the Cambridge laboratories and includes important projects on high-altitude problems, as well as on special phases of aviation medicine. The science of electrocardiography in America has been developed almost entirely upon the Cambridge-built Electrocardiograph. Used in virtually every aviation medical center and in air-line flight surgeons' offices, this important diagnostic instrument gives positive proof of the condition of the heart muscle by recording the minute action currents developed by the heart as it beats. This infinitesimally small current enables the heart to write its action-story so legibly in electrocardiogram form, that a heart specialist can appraise its every movement. The sensitive element of the Cambridge Electrocardiograph in a string galvanometer in which the heart currents cause deflections of a fine gold-plated quartz fibre stretched is a strong magnetic field. The projected shadow of this fibre, magnified and moving across a brilliantly illuminated field, falls upon a moving strip of film or paper and its deflections are thus continuously photographed. At the same time horizontal lines to measure the amplitude of the swing of the shadow, and vertical lines to measure the time interval between deflections are recorded directly upon the film or paper.

Lighter-than-air craft builders also use Cambridge instruments. When wartime conditions created the need for fabrics treated to hold hydrogen, helium, etc., Cambridge designed and made available the Fabric Permeameter for the production testing of treated fabrics and sheet materials. This instrument determines the rate of gas diffusion through proofed materials used in the manufacture of balloons, life rafts, life jackets, gas masks and similar products.

Other Cambridge instruments are used to measure horizontal, rotational, and vertical vibration; internal damping capacities of materials; acceleration and deceleration; minute direct and alternating potential, current and power quantities; field strength of magnets; humidity; temperature; hydrogen-ion concentration; various components in liquids and gases; also for oscillographic recording of transient electrical phenomena; geophysical prospecting; etc. Along with the designing and production of instruments for use in aviation, Cambridge continues to build outstanding precision instruments for production, testing and research in steel mills, power plants, oil refineries and other process industries and manufactories.



CAMBRIDGE "A" ENGINE AERO MIXTURE INDICATOR COMPRISING INDICATOR UNIT AND 4 ANALYSIS CELLS



23 YEARS AGO FIRESTONE

Today Firestone

TODAY . . . IN WARTIME

TODAY American fighting men are stationed from Iceland to Australia, from the Aleutians to the Congo. With them, they have brought American equipment, American standards of living and American spirit. As a result, when peace comes, there will be a world-wide demand for American goods.

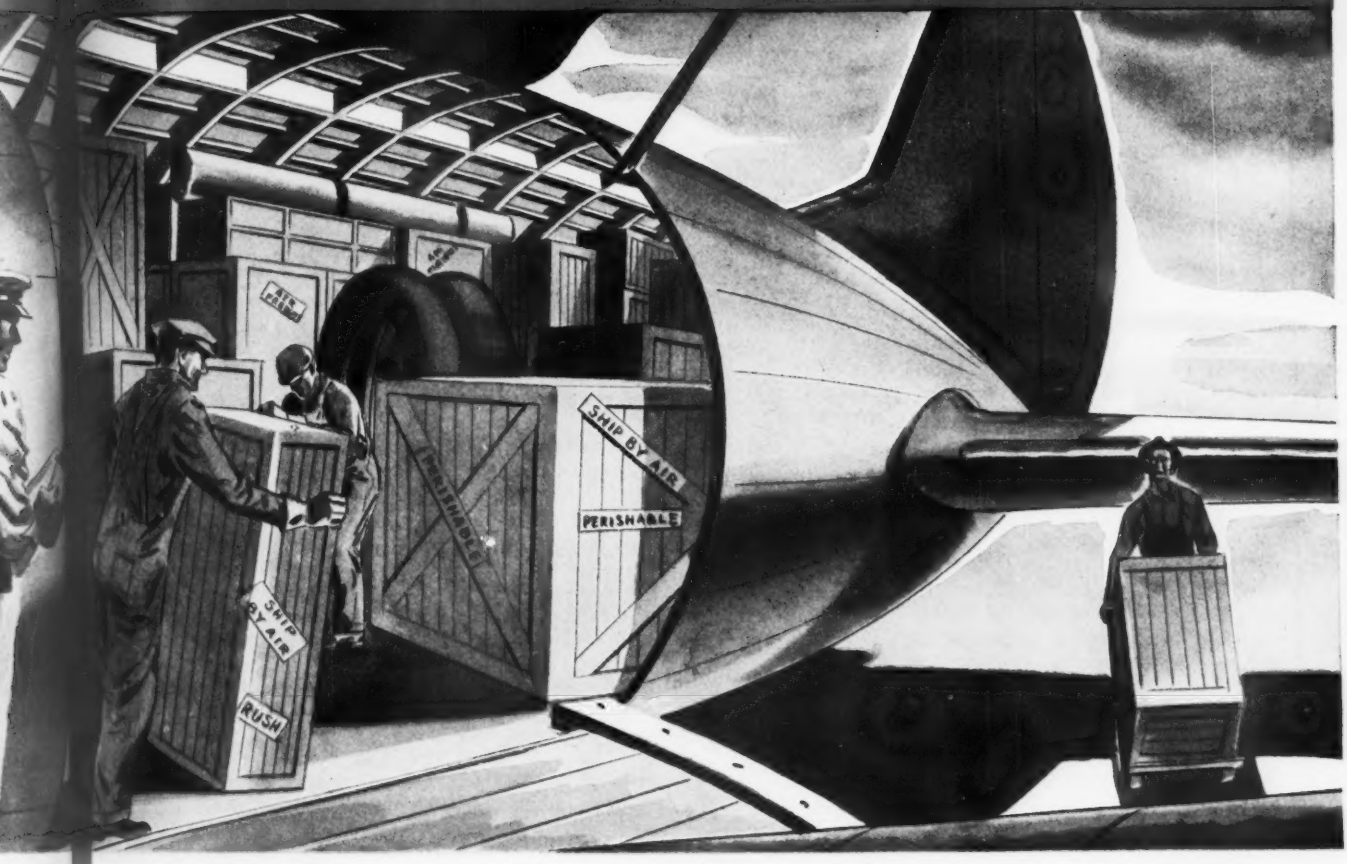
To the seaways, railways and highways will be added a fourth dimension in transportation — the skyways. By ship, by train, by truck, by plane the products of American Industry and American Agriculture will pour forth to every corner of the earth. In this expanded world traffic, each type of transportation will have its place. And each will continue to rely on Firestone, as it has in the past, for much of its equipment.

For example, giant air freighters will fly

THE FOURTH DIMENSION

PIONEERED "SHIP BY TRUCK"

PIONEERS "SHIP BY AIR"



TOMORROW . . . IN PEACETIME

on wings built by Firestone, land on tires, wheels and brakes by Firestone, require many other products of the Firestone plants for safe and dependable operation.

Whenever speed is the prime consideration, goods will be shipped by air. And, as you would expect, Firestone is pioneering "Ship by Air" — just as Firestone has throughout the years pioneered so many other notable advancements in transportation.

Firestone was the first Company in the rubber industry to win the coveted Army-Navy "E" Award for high achievement in the production of war materials.

Listen to the Voice of Firestone with Richard Crooks, Margaret Speaks and the Firestone Symphony Orchestra, under the direction of Alfred Wallenstein, Monday evenings, over N. B. C.

Copyright, 1943, The Firestone Tire & Rubber Co.

IN TRANSPORTATION ★ ★

Will Your "FORTRESS" Be Ready On Time?

Think of the months of training and practice this bomber crew put in before they were ready for the real test.

ALTER EGO: And, think of the *years* of effort engineers and shop men put into the development of the "Flying Fortress" . . . all to enable the crew to rule the airways—to navigate in a bee-line to the destination, fight off "competition" all the way, hit the target and get home safely.

Like the YEARS of preparation that'll be required to develop fortresses of knowledge before business crews can expect to rule the post-war market ways.

ALTER EGO: Right! It'll take shrewd management to steer a course of profits . . . ingenious designing to fight off tough competition . . . efficient production to hit the mark of rock-bottom costs and top quality. All of this *to survive.*

All of which is embodied in the practiced use of arc welding. There's our fortress for survival in the Battle for Business. Let's start developing our welding knowledge NOW by consulting Lincoln.

Ask your inner self if time isn't getting short for post-war planning

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

then I said to myself—

WELDED PRODUCTS HIT THE TARGET

OFFICIAL PHOTO U. S. ARMY AIR FORCES

Acrylics in Aviation

D. S. FREDERICK*

THE COMMERCIAL HISTORY of acrylic plastics and their use in the aviation industry falls largely within the past decade. Over this period, the Rohm & Haas Company has been privileged to play a leading part in supplying acrylic plastics for use in aircraft and in assisting aircraft manufacturers in the application of these materials.

To the aircraft engineer an acrylic is a tough, lightweight, shatter-proof synthetic resin that has made possible today's streamlined nose sections, cockpit enclosures, gun turrets and other similar aircraft parts. To the paint chemist, however, an acrylic is a solution especially suited to clear and pure white coatings that are hard, tough, resistant to chemicals and impervious to odors. To the tanner, it is an emulsion making possible flexible finishes for fine leather. To men in many other industries it is a highly specialized material meeting the requirements of a highly specialized job.

This diversified development of the acrylics is based on the original research of Dr. Otto Rohm, one of the founders of the Rohm & Haas Company. His doctorate thesis, published in 1901, was the foundation of further research in his laboratory which resulted in the first large-scale production of acrylics in 1927, when Rohm & Haas introduced "Plexigum," an adhesive for laminated safety glass. Since that time the Rohm & Haas Company has developed and manufactured acrylics in the form of emulsions, solutions, denture material, molding powders, rods and sheets—the last two items being marketed under the registered trademark "Plexiglas." As a result of the inherent advantages of Plexiglas, and the technical services rendered by our Company, the use of Plexiglas increased until by 1939 it was recognized as the standard plastic in military aircraft.

Research and development problems behind Plexiglas were many and complex. Plexiglas was the first optically clear plastic. There was no prior art. There were no scientists skilled in the art. Established methods of manufacturing Plexiglas sheets by calendering, slicing and molding proved completely unsatisfactory. New methods of polymerizing the monomer to make possible cast sheets had to be developed. The contraction of acrylic monomers in polymerization, the sensitivity of the reactions, the necessity of maintaining absolutely colorless transparency, excellent optical properties, and highly polished surfaces, and many other factors presented serious problems that had to be solved.

After satisfactory processes had been developed in the laboratory, they had to be adapted to large-scale production. Although recognized principles of organic chemistry are employed in the synthesis of acrylic monomers, the processes are quite complicated. Traces of impurities in the monomers seriously affect the qualities of the finished sheets. To achieve optical clarity, plant operating-conditions of almost medical cleanliness had to be developed to eliminate dirt and dust. Air-conditioned factories with controlled temperature and humidity had to be constructed.

When Plexiglas was first introduced, the sheet plastics fabricating industry was largely composed of manufacturers of novelties and other consumer goods who were not equipped to fabricate to the close tolerances of the aircraft industry. Until the use of Plexiglas in planes was established, none of the aircraft companies was interested in fabricating. It was necessary, therefore, to set up a fabricating department and to develop fabricating methods. It was found advisable not only to modify the accepted techniques for machining other plastics but to develop entirely new methods and equipment for forming large two- and three-dimensional curved sections to meet high optical standards.

As an example of the way the Company has participated in the development of acrylic plastic sections, Rohm & Haas was called into consultation when Plexiglas power turrets, now standard equipment on all bombers, were first being designed in 1937 and also were consulted with regard to the first all-plastic bomber nose in 1939, which we later built. The Company assisted in modifying the design of this part, fabricating successive experimental sections, and finally put the part into quantity production.

These new uses of Plexiglas led to greater demand for the material. To meet this demand the Rohm & Haas Company has repeatedly increased its production capacity. No small part of the problems encountered in doing so was the training of new employes, including 20 per cent women, in the handling of a sensitive chemical process requiring absolute purity of raw materials and freedom from dirt or other contamination that would impair optical properties. As a result of its successful production record, the Company was awarded the contract to operate a new, Government-financed plant to be put into operation within the next few months.

The technical service the Company has rendered since the introduction of Plexiglas remains a significant feature of its contribution to the industry. All the representatives have been trained in the Company's plants and laboratories. They bring to customers the benefits of experience in Plexiglas and the technical data that result from the continuing research that is being conducted.

In addition to working directly with customers through representatives, the Company has served the aircraft industry through the publication of detailed technical data obtained in its laboratories. Methods of repairing Plexiglas parts at front-line bases have been developed, and information concerning them widely distributed. Similarly, fabricating data, suggested methods of installation, information on testing methods, physical data, and other essential information have been printed and made available to all members of the aircraft industry. Rohm & Haas has also prepared a sound motion picture for training the industry's new employes showing proper methods of fabrication, maintenance, and repair of Plexiglas sections. When aircraft manufacturers desire to undertake fabricating in their own plants, their representatives are given full access to the fabricating department and are instructed in the Company's fabricating techniques. Similar services are also available to Army and Navy aircraft station and training schools. Technical representatives are calling on these stations and schools and giving instruction in fabricating, maintenance and repairs.

Since the outbreak of the War, of course, the research and development program has been concentrated almost entirely on war problems. The resistance of Plexiglas to bullet impact, its behavior at stratosphere temperatures, the deflection of Plexiglas panels under pressure and other problems are all being studied intensively and reported to the aircraft industry.

* Sales Manager, Plastics Division, Rohm & Haas Company.

America's Oil and American Victory!

AS far as we know, the best aviation gasoline the enemy can produce in quantity is 91-octane gasoline.

American combat planes fly with 100-octane gasoline. That means that gallon for gallon they have a potential power advantage of about 20 per cent.

This didn't happen just because we have more petroleum than the enemy. Our pilots fly with 100-octane gasoline because America's Petroleum Industry knows how to make better use of petroleum than the enemy does.

In a never-ending peacetime hunt to get better products from petroleum... we in the Esso Research Laboratories pioneered in the development of 100-octane gasoline.

Because of this same research... our boys today have special lubricants as dependable on Russia's coldest steppe as over Libya's most torrid dunes or the Solomons' sweltering jungles. And special hydraulic oils for operating controls in planes and guns in temperatures where the ordinary product would freeze and lock the equipment into uselessness.

Because of this same mastery of petroleum science ...our flyers are getting synthetic rubber that, for specialized uses, surpasses the real thing.

Because of this work... our country can make all the TNT we need to beat the Axis... and the important ingredient—Toluol—is now being made from petroleum.

The whole list of such products developed over the years by continuing Esso research helps to explain why the United States, in peace or war, has done more than any nation on earth to make oil the servant of man.

Western Electric Contributes to Aeronautical Progress

F. C. McMULLEN*

THE SCIENCE of communications has taken gargantuan strides during the past decade. The development of commercial aviation on an unprecedented scale made distances so shrink as to cause a complete readjustment in the psychologic relation of man to his environment. None of the other auxiliary sciences played a greater part in this aerial expansion than that of radio. Nowhere was the development of aviation radio more diligently pursued than by the Western Electric Company and Bell Telephone Laboratories.

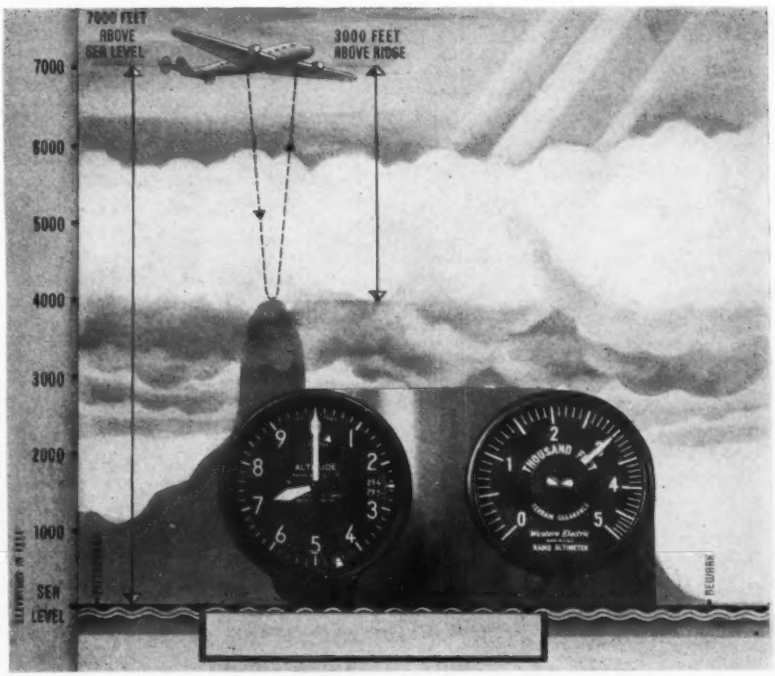
Among the outstanding contributions from 1932 to date may be listed the crystal controlled superheterodyne communications receiver for commercial planes. Here we were able to provide the pilot for the first time with the selectivity so desirable for aviation radio communication, while relieving him from the exacting process of manual tuning.

The use of preselected frequencies in this receiver stemmed directly from one of the most important developments in aviation radio of the time: the so-called "AT cut" crystal. By means of this new technique, we were able to produce quartz crystal substantially free of the temperature effects that had previously caused wide variations in heating oscillator frequency and, accordingly, in receiver tuning.

During these years active research was carried on by means of the Bell Laboratories' "Flying Telephone Booth," and extensive tests were made on many important projects such as instrument landing. As early as 1933, successful instrument landings were being made by the Laboratories' plane under conditions simulating those encountered in routine operation.

One of the most interesting developments during that period was the ultra-high-frequency absolute altimeter, or terrain clearance indicator, culmination of years of research. With this indicator a pilot was freed from sole reliance on his barometric altimeter, and the uses to which the new instrument could be put were many. So important was this contribution to aviation that one of the engineers engaged in its development was honored with the Lawrence Sperry Award, one of the few instances in which this award has been made for work in aviation radio.

* Western Electric Company, Inc., Radio Division.



Graphic demonstration of the advantages of the Western Electric terrain clearance indicator. The dial faces (insert) show readings that a pilot might take over the highest point between Pittsburgh and Newark. The conventional barometric altimeter (left) shows the plane's height above sea level to be 7,000 ft., while the terrain clearance indicator dial shows the plane's actual height above terrain to be only 3,000 ft. In cross-country flight the indication of altitude above ground will show variations according to the contour of the terrain below the airplane. Thus, the pilot familiar with the topography along his route is provided with a supplementary navigational aid.

Constant research in the field of electronics resulted in 1939 in Western Electric's construction of the first practical azimuth indicating radio receiver. Western Electric's work on this project has had fortunate and far-reaching results.

The latter half of the decade saw many new concepts in radio telephony come to the fore, not the least of which was a growing interest in the application of ultra-high-frequency waves. Here, in a static-free portion of the radio spectrum, the nation's air lines collaborated with the Western Electric Company on a long-range, far-seeing program involving both navigation and communication. Unfortunately, the development of the commercial aspects of this program was halted, first by the needs of national defense, later by the stress of actual war.

As was to be expected, the development of communications for commercial aviation has given way to military necessities. Under wartime conditions, the experience gained in this field during the years of peace has borne fruit in many pieces of equipment for the armed forces which cannot be discussed in this article. Western Electric has been converted to war production as far as possible without inviting disaster on the home front through the collapse of indispensable civilian communication. In recognition of its efforts in providing communications equipment for the armed forces Western Electric has been awarded one of the first of the joint Army-Navy "E" pennants. And it is significant that one of these awards was made on August 28, 1942, for that marked the silver anniversary of the day during the last war when Western Electric engineers, in collaboration with the United States Army, first demonstrated the practical use of ground to plane radio communications for command purposes.

Data on Du Pont "Lucite" sheeting for aircraft designers, engineers and their established enclosure suppliers. This is the first of a series of advertisements intended to aid the war production effort.

WHAT MODIFIES TENSILE STRENGTH OF DU PONT "LUCITE"?

A property of utmost importance in cast "Lucite" methyl methacrylate resin sheeting is *tensile strength*. Under standard conditions of 77°F. and 50% relative humidity, "Lucite" has a tensile strength of from 6,000 to 9,000 pounds per square inch. Various physical conditions in actual service so affect the plastic, however, that for design an operating tensile strength of from 650 to 1,000 p.s.i. is a necessary recommendation.

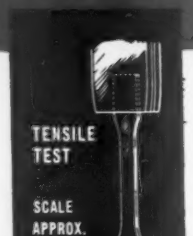
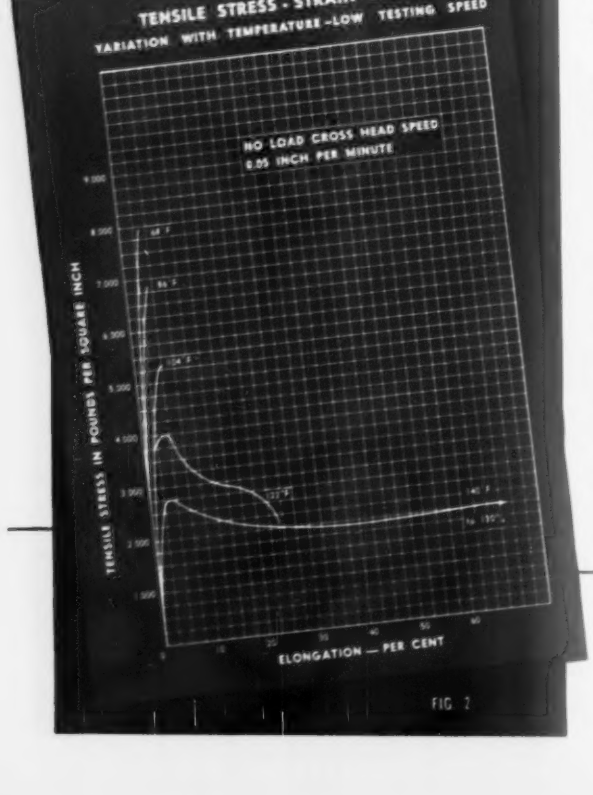


FIG. 1

Test method: A. S. T. M. procedure D229-39T. Upper end of standard test bar is gripped by fixed jaw. Lower end is clamped in movable jaw, drawn downward at set rate. Test bar transmits tension to upper jaw, connected to weighing device. When bar fails, tensile strength is found by dividing load by initial cross-section of test piece.

TEMPERATURE is one of the modifiers of maximum tensile strength. The tensile strength of all plastics varies inversely with the temperature. See Figure 1 for stress-strain curves obtained on cast "Lucite" sheeting at various temperatures.

FATIGUE is shown by all plastics subjected to stress. Test bars fail *under continuous loads* below the breaking point of bars to which the load is quickly applied. Tests show that "Lucite" cannot stand indefinitely more than *half* the breaking load at low testing speed. Approximate values may be obtained (See Fig. 1) for each given temperature and with allowance for the usual safety factor of 2. Yet design must allow also for decreased tensile strength with increase in temperature, and for possible crazing of plastic under excessive strain. Thus, below 77°F., fiber stress above 1,000 p.s.i. should be avoided. For temperatures between 77° and 100°F., a maximum operating stress of 650 p.s.i. is recommended.

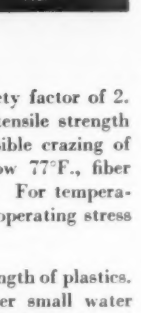

TENSILE STRESS - STRAIN CURVES
VARIATION WITH TEMPERATURE-LOW TESTING SPEED
NO LOAD CROSS HEAD SPEED
0.05 INCH PER MINUTE
TENSILE STRESS IN POUNDS PER SQUARE INCH
ELONGATION — PER CENT
FIG. 2

MOISTURE content reduces the tensile strength of plastics. However, "Lucite" becomes saturated after small water absorption. After soaking in water at 77°F. for 72 hours, its tensile strength is reduced by only 2 per cent.

ORIENTATION—alignment of molecules—produced in the molding and forming of plastics may cause tensile strength differences of 10 to 20 per cent. Tensile strength increases in the direction of alignment, decreases on the perpendicular.

SHAPE AND RELATIVE SMOOTHNESS of plastic products cause variation in tensile strength. Fillets of large radii should be used when design calls for sharp bends, and products should have a smooth finish.

SEE THIS MANUAL FOR MORE DATA



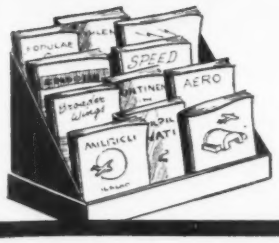
114-PAGE AIRCRAFT MANUAL ON "LUCITE" has been prepared by Du Pont as a helping-handbook for aircraft producers. Gives valuable information on how to fabricate, form, polish, clean, install and repair "Lucite." Includes data on mechanical, thermal and chemical properties. Get your *free* copy. Write on your business letterhead to: E. I. du Pont de Nemours & Co., (Inc.), Plastics Department R, Arlington, N. J., or 5801 So. Broadway, Los Angeles.

DU PONT

"LUCITE"

REG. U. S. PAT. OFF.

METHYL METHACRYLATE RESIN



Periodicals

Accessories

Remote Control of Hydraulic Installations. C. G. Hebel. A discussion of the various types of control equipment for aircraft parts accords a brief review to mechanical, vacuum, pneumatic, and electrical controls and indicates the advantages of the hydraulic method. The development of the hydraulic type is traced from its original function as an auxiliary or standby equipment for electrical control, it being stated that the hydraulic system is rapidly replacing the electrical. Details of the operation of various hydraulic devices are given, as well as their applications in aircraft. Simplicity of control is stressed. *Aero Digest*, December, 1942, pages 228, 230, 233, 7 illus.

Recharging CO_2 Cylinders. J. M. Noble. It is stated that nearly every American bomber and fighter uses carbon dioxide gas for one or more purposes. The gas is used to inflate life rafts, supply the means for extinguishing airplane fires, and supply emergency power for lowering retractable landing gear. Because warplanes are usually far from recharging stations, it is usually necessary to recharge on the spot the cylinders with which they are equipped, by taking the gas from large cylinders provided for the purpose. The article provides an explanation of how this should be carried out. *Air Tech*, November, 1942, pages 39, 56, 2 illus.

Methacrylate Disk Warns of Ice Formation. The writer describes how a plastic disc set in the leading edge of an airplane wing is used as a detection element of the ice indicator manufactured by the Minneapolis-Honeywell Regulator Company. Utilizing principles of electronics, it is stated the indicator measures the thickness of the ice accumulation and turns on the deicing equipment at the moment when it will be most effective *Modern Plastics*, December, 1942, page 47, 2 illus.

Design and Installation Factors for Aircraft Hydraulic Accumulator Systems. Edward M. Greer. An analysis is presented of accumulator systems, particularly those used in aircraft operation. The hydraulic accumulator is defined and the four elements that govern the size and

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

type are set forth, with explanations of the functions performed. The development of hydraulic accumulator systems is traced from the elementary types used in stationary industrial installations to present-day devices employed in aircraft. Each of the principal types is described in detail; these include the gravity type, the spring-loaded unit, and the four kinds of air-loaded accumulators. Principles of operation of the air-loaded types are explained, with information on methods of installation. Illustrations consist of sectional drawings, sketches of installations, and circuit diagrams. *Aviation*, December, 1942, pages 150–155, 311, 11 illus.; "Development of Hydraulic Pressure Accumulators," by Nicholas DeKiss, *Aero Digest*, December, 1942, pages 130, 136, 138, 7 illus.

Design Simplicity Prerequisite of Hydraulic Control Standardization. John W. Kelly. The writer explores the fundamental requirements for hydraulic equipment for aircraft, particularly the devices for controlling such equipment. A detailed description is given of the design for the Adel hydraulic selector valve and the functions it is intended to perform. Variations of this design under different trade designations are also described thoroughly. *Aero Digest*, December, 1942, pages 211, 212, 215, 216, 218, 276, 279, 7 illus.

Electrical Equipment for Aircraft—DC Generators. P. M. Heldt. The writer reviews the development of aircraft electrical equipment, which, it is noted, has been rapid since the advent of the large transport plane. The article has particular reference to d.c. generators. Comparisons are drawn between American automobile electrical equipment and that of aircraft. Compared with automobile generators, the generating capacity required for a modern transport or military plane is much greater. It is explained that the aircraft generator must be as light as possible yet fully as reliable as the generator for automobile service. Attention is given to generator drives, the advantages and disadvantages of the storage battery, and the use of a generator driven by a special gasoline engine. Details of generator design and performance as applied to aircraft are discussed. *Automotive and Aviation Industries*, December 15, 1942, pages 36–39, 7 illus.

Aerodynamics

Flight Testing for Performance and Stability. Edmund T. Allen. The Sixth Wright Brothers Lecture, presented before the Institute of the Aeronautical Sciences by the director of flight and aerodynamics of the Boeing Aircraft Company, opens with a brief review of the progress made in aircraft and engine design and the contributions of the science of aerodynamics since the historic first flights of the Wright brothers 39 years earlier. An explanation follows of the methods of flight testing in the wind tunnel and in actual flight, comparing methods of the past with the present procedure, which is termed an "aerodynamic approach." The value of parallel testing in flight and wind tunnel is emphasized, and it is noted that a satisfactory design answer to flight problems may be obtained in a shorter time than would be possible without the guidance of the tunnel tests.

Flight testing is classified in two primary divisions—namely, performance and stability. Taking up first the matter of performance, the fundamental requirements are set forth as: (1) instrumentation for the measurement of all variables (2) accurate flying technique for representation of the true optimum performance of the airplane; (3) steady air, with reasonable temperature pattern and no vertical currents; and (4) a mathematically correct analytic method to apply to the flight-test data. It is shown that modern procedure has overcome much of the difficulty and

WE'VE MADE BILLIONS

—and not one has loosened

THEY'RE on oil well pumps—some for twelve years.

They're standard equipment on rock drills — industry's toughest fastening problem.

They're on tanks, planes, guns—all kinds of wartime material—all kinds of peacetime equipment.

All told, billions of Elastic Stop Nuts have gone to work.

And as far as we know, not one has failed to do its job.

That job is to hold fast and stay put—come what may in the way of vibration, jar or chatter.

Of course the need for such dependable fastenings in war goods and planes is paramount. Some planes take as many as 35,000 in a single ship.

So even at our 4,000,000-a-day rate (which soon will double) the demand keeps growing.

But this constant call for more and more—to meet the exacting responsibilities of war—gives ample proof that Elastic Stop Nuts answer every need for secure locking and speedy fabrication.

Seals, threads at top prevents corrosion of working threads.
Fits standard bolt.
Tough, elastic locking element.
Locking collar cannot harm the bolt threads.

Write for folder explaining the Elastic Stop self-locking principle.

ELASTIC STOP NUT

CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

INDEX to Periodicals

Accessories	29
Aerodynamics	29
Air Cargo	31
Air Law	34
Air Policy	35
Air Power	35
Air Transport	36
Airplane Descriptions	39
Airports	39
Armament	39
Avigation	39
Blind Flying	39
Business and Finance	43
Civil Air Defense	43
Civil Aviation	43
Control Equipment	43
Design	43
Engines	49
Flight Technique	51
Flight Testing	53
Fuels	53
Gliding and Soaring	53
High-Altitude Flying	53
Instruments	53
Landing Gear	53
Maintenance	53
Management	55
Materials	55
Medicine	56
Metallurgy	57
Meteorology	57
Military Aviation	57
Model Airplanes	61
Naval Aviation	63
Parachutes	63
Personalities	64
Personnel	64
Photography	65
Plastics and Plywood	65
Private Flying	67
Production	67
Propellers	71
Rotating Wing Aircraft	71
Stress Analysis	71
Superchargers	73
Testing	73
Testing Equipment	73
Tools and Equipment	73
Training	77
Warfare	79
Welding	79

confusion formerly experienced in flight testing and analysis of the data obtained. The application of engine and propeller data is explained, together with the airplane polar method. Charts show variations resulting from propeller solidity correction, tip-speed corrections, and the relationship of propeller-tip speeds to airplane drag.

Difficulties in reduction of climb test data are discussed, as well as power-plant performance tests and operating characteristics. Other essentials for obtaining satisfactory performance data include crew considerations; instrumentation; air-speed measurement; outside temperature measurement; and readings of torque, engine speed, manifold pressure, back pressure, and other data. Weight and configuration control and weather conditions are among the most important factors. Means of recording data through photographic instruments are described. Rules for satisfactory performance are summarized.

The second part of the lecture is devoted to stability tests. Airplane trim conditions are discussed in connection with the determination of static longitudinal stability, and other flight-test problems are considered with reference to the shifting of the center of gravity, trim tab problems, and miscellaneous problems. The reduction of test data to mathematical form is explained, along with the derivation of the power index. A comparison is presented of wind-tunnel and flight stability tests, illustrated by numerous figures, as well as other stability tests within the scope of the paper, although it is stated that a complete treatment of all phases of stability and controllability would require a text.

The conclusion is reached that flight testing is becoming an exact science and that the current advances in the field of flight testing will be felt more and more as a highly influential factor in future aeronautical progress. The work of Orville and Wilbur Wright is being carried to a new level, with the same spirit of the painstaking scientific process of experimentation and analysis, to achieve still further design progress.

Five discussions are appended, the discussers being Dr. Norton B. Moore, of Curtiss-Wright Corporation; W. K. Ebel, of The Glenn L. Martin Company; Melvin N. Gough, of the National Advisory Committee for Aeronautics; A. Lewis MacClain, of Pratt & Whitney Aircraft Division, United Aircraft Corporation; and Clark B. Millikan, of the California Institute of Technology. *Journal of the Aeronautical Sciences*, January, 1943, pages 1–30, 38 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Graphic Determination of Distance in Accelerated Airplane Motion. G. A. Mokrzycki. In a short paper a mathematical process is developed for computing distances for airplane take-off, landing, diving, and other maneuvers. Examples are presented for the cases of take-off distance for a landplane and a seaplane and the landing run for these types of aircraft. Diving and zooming are considered under conditions of constant atmospheric density and variable density. A second approximation can be obtained if necessary by plotting a curve for conditions as set forth whereby more exact values can be determined for the distances involved. *Journal of the Aeronautical Sciences*, January, 1943, pages 36, 37, 5 illus.

Kinetic Energy in Partial Climbs. A. G. Hurn. A mathematical analysis is furnished of the increase in the kinetic energy of an airplane during a climb. It is pointed out that in order to maintain constant air-speed indicator readings during a climb the forward speed of the airplane must increase, which means that there is an increase in the kinetic energy of the airplane as well as in the potential energy. In performance reduction this increase in kinetic energy usually is neglected. The writer shows that for climbs carried out at high speeds the correction is sufficiently large to be considered. *Aircraft Engineering*, November, 1942, page 319.

The Heart of the Matter. Wolfgang Langewiesche. A detailed explanation of what is meant by the angle of attack and how it affects the operation of an airplane. Defining the angle of attack as the angle at which the wing meets the air, the article studies the application of its principle during various conditions of flight. These include: cruising, slow speed, landing, glide, climb, power stall, and power descent. The relation angle of attack to relative wind and the importance of both are also discussed. *Air Facts*, January, 1943, pages 46–66, 8 illus.

Air Cargo

Gliders Plus Pick-ups as a Practical Air Cargo Formula for America. Richard C. du Pont. An analysis of the possibilities of the air pickup system as an aid to the efficient movement of cargo by air is presented by the president of All American Aviation, Inc. What can and cannot be expected of the use of gliders plus pickups is discussed. It is concluded that the short-haul field offers the best opportunity for commercial glider operations. What already is being accomplished with air pickup systems is reviewed. *Air Transportation*, December, 1942, pages 28–35, 1 illus.; "Cargo Glider Pickup," *Mechanical Engineering*, January, 1943, pages 35–39, 3 illus.; "Du Pont Sees Short-Hand Use for Gliders on Future Airlines," *American Aviation*, January 1, 1943, pages 36, 37, 1 illus.; "All American Head Sees Short Hauls Efficient for Gliders," *Contact*, January, 1943, pages 7, 28.

The Air Freighters. F. N. B. Bentley. From a consideration of the uses to which the United Nations would put air freighters, specifications are evolved for the type of plane needed. This is indicated as a 60-ton plastic-wood landplane, the cruising speed of which should be upward of 170 m.p.h.; the maximum operation, 12 to 14 hours. Its capacity is established at 150 fully equipped troops. The writer rejects the conversion of freighters from bombers as being not feasible, giving his reasons why. *Flight*, December 3, 1942, page 608.

All-Cargo Plane Seen as Ultimate Answer for Post-War Trunk Lines. Extracts are presented from a paper read before the Society of Automotive Engineers by J. V. Sheehan, of Lockheed Aircraft. The writer explains why he believes the all-cargo plane will be the ultimate solution to the problem of postwar transport. He states, however, that combination passenger and cargo planes may be used for a short time. It is asserted that the cheapest operating cost per ton-mile can be obtained with the largest plane. *American Aviation*, December 15, 1942, page 23, 1 illus.

New Plane Types Needed for Cargo Success: A Dual Report: Part I, Charles Froesch; Part II, Carlos Wood. In Part I of this dual report the writer refers to the increased volume of cargo which air lines have been called on to transport in the last ten months and calls attention to cargo-handling and transportation problems that must be

This shape is rolled from Alcoa Aluminum Alloy sheet in a single operation. Its use may take the place of a thicker extruded shape, thereby releasing metal and extrusion presses for production of vital war materials. Its producer is one of many companies who are roll-forming similar aluminum-sheet shapes.

Many of these rolled-sheet shapes, being produced today for war products, are made of heat-treated aluminum alloys to give them high strength. Often, the "as-rolled temper" strip is fed right from the heat-treating furnace to the forming rolls, before the metal can age-harden, thus avoiding distortion that might occur if heat treatment followed forming.

Also shown above, in silhouette, are other rolled-sheet shapes. It doesn't take much stretching of the imagination to visualize a great variety of these aluminum shapes used in numerous products. Exactly the right thickness and shape for strength and stiffness, but no more metal than is actually needed.

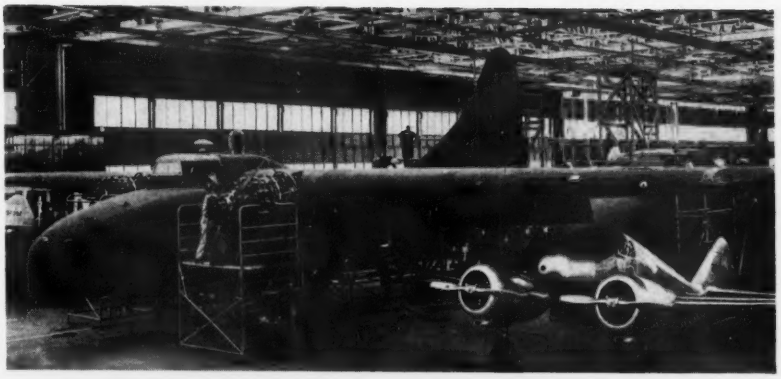
The economies possible with large quantity production are certain to cause these aluminum rolled-sheet shapes to be adopted widely for all kinds of postwar applications. ALUMINUM COMPANY OF AMERICA, 1980 Gulf Building, Pittsburgh, Pennsylvania.

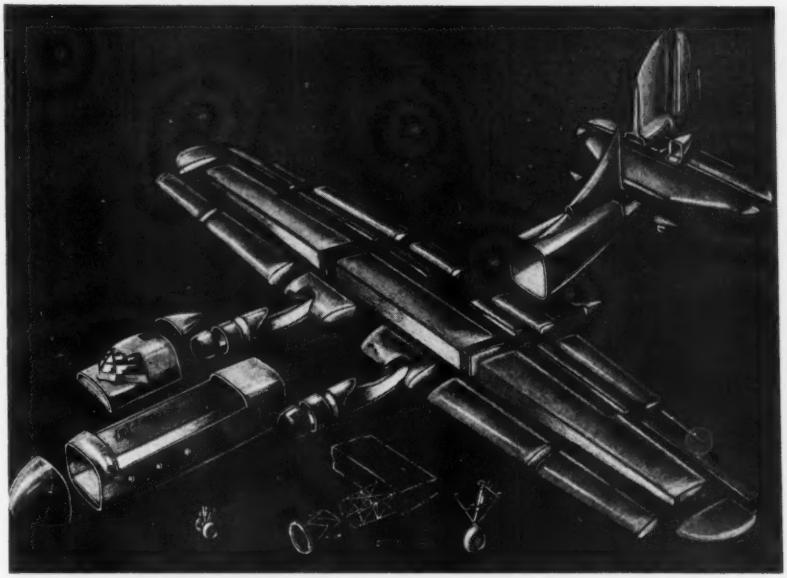
ALCOA ALUMINUM

solved before air-cargo transportation can become a routine operation. It is stated that at this time no one knows just what a cargo plane ought to be. The conditions in the design of cargo planes where there is need for improvement are listed. As a prelude to a tentative presentation of operating requirements for cargo planes, consideration is given to fundamental laws that apply to the transportation of air cargo. Operating requirements are discussed in considerable detail. It is concluded that, generally speaking, the type of cargo airplane which appears most suitable is a high-wing, twin-engined plane with tricycle landing gear, although for larger capacities and longer range a four-engined, low-wing type might be superior. Operating requirements met by the twin-engined plane are enumerated and design features are discussed.

The writer of Part II of the report discusses the design of the cargo plane. It is stated that the cargo plane must be built around the cargo compartment. Compartment design requirements are outlined. It is explained that for a given size of airplane the range at which maximum cargo utility is available and also the maximum range are functions of the basic layout of the airplane. Design conditions must be set up to define the conditions under which it is intended to use the plane. Basic factors to be considered for a cargo plane are discussed in paragraphs covering weight, drag, span, power, stalling speed, and handling time. Design trends evident both from a military and a commercial standpoint are enumerated. *Air Transportation*, December, 1942, pages 40–44, 46–49; "Specially Designed Freight Aircraft Needed for Post-War Use," by Charles Froesch, *American Aviation*, December 15, 1942, pages 20, 24, 27, 36, 3 illus.; "Designing Better Cargo Planes," by Charles Froesch, *Aviation*, December, 1942, pages 363, 364, 367, 368, 371, 372, 375, 376.

Army Tests Show Glider Adds 59% to DC-3 Capacity. An article incorporating extracts from a paper read by Major Lewin B. Barringer before the Society of Automotive Engineers in which it is stated that Army Air Forces tests show that a 15-place glider of commercially inefficient design towed by a Douglas DC-3 airplane offers a 59 per cent increase of cargo over that of the tow plane on 800-mile flights. The writer believes that with a large glider especially designed for use with a towing transport plane a greatly increased payload could be transported with a small decrease in the general efficiency of operation of the airplane alone. *American Aviation*, January 1, 1943, page 18.





(*Top*) The new Curtiss (C-76) Caravan in production. Built almost entirely of wood and other nonstrategic materials, it is the first wood military cargo plane to be developed. Note the twin-engined (AT-9) Jeep beneath the wing of the foreground. The new "air freighter" is a high-wing monoplane, has a wing span of 108 ft., is 68 ft. long, and is powered with two 1,200-hp. engines. No details on its performance or cargo capacity have been released.

(*Bottom*) Production breakdown drawing showing how sections of the Caravan are joined together. (*See* "From the Industry.")

Freight—by Air. Sigmund K. Lohn. The need for coordination by air-lines and motor truck systems in the promotion of large-scale air-freight operation is analyzed. In order that air cargo may compete with other forms of freight transportation, the writer points out, not only must more complete coverage of the United States outside the limits of existing airways be provided but also pickup and delivery service. He suggests two plans for determining a scale of rates for combined air and motor truck transportation. One is by charging a joint tariff for complete door-to-door service. Such tariffs would concern rates for air cargo and associated truck movement over one air line only. The other is by having an established scale of charges for all air lines which would not include the rates for truck cartage. The charges for motor transportation, already on a regulated basis, would then be additional to those of the air carriers.

The article includes discussion of plane load and less-than-plane load shipments, advising a variance in their service and in computing charges for them. It examines types of equipment and aircraft which are adaptable for large-scale air-freight operation. The fact that air-express shipments need not be discontinued with the establishment of air-freight transportation by the air lines is also brought out. *Flying*, January, 1943, pages 59, 60, 96, 98, 1 illus.

Cargo Plane Design Not Immediate Need. E. J. Foley. In this article it is shown that the success of air transport depends on the maximum utilization of an efficient transportation

vehicle. He states that manufacturers should concentrate on improving the ground efficiency of air lines. It is suggested that manufacturers loan design engineers to air-transport operators, where they could assume positions on the engineering staff of the operators, witness the operators' problems, and report their findings to the engineering staff at the factory. *American Aviation*, January 1, 1943, pages 38, 52, 1 illus.

Freight Forwarders Will Aid Air Cargo Operation. Thomas A. Bradley. The writer of this article sees freight forwarders playing an ever increasing role as the gathering and distributing agents for all forms of transportation. He points out that in the first World War transportation benefited from the truck as a medium of handling traffic and predicts that this war will widen the use of the airplane as a popular form of transportation. *Air Transportation*, December, 1942, pages 20–23.

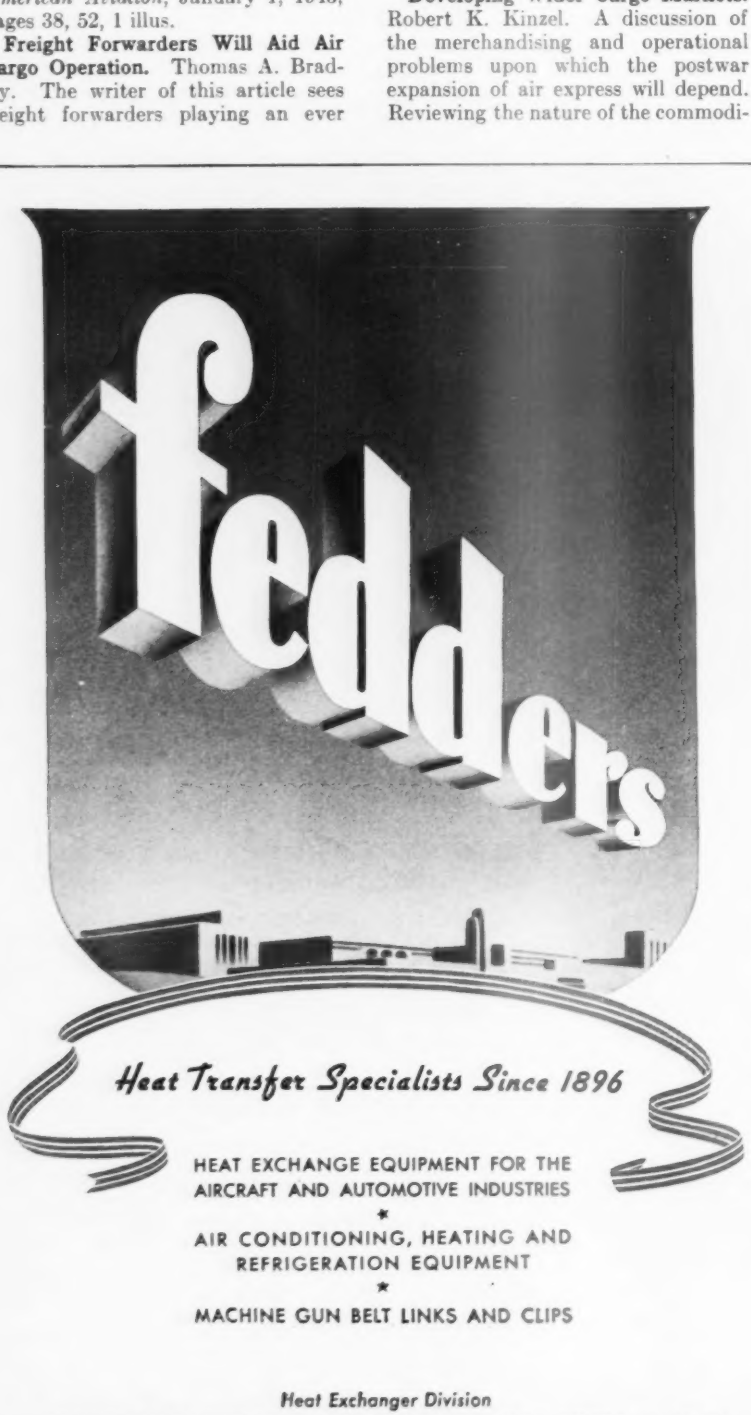
Developing Wider Cargo Markets. Robert K. Kinzel. A discussion of the merchandising and operational problems upon which the postwar expansion of air express will depend. Reviewing the nature of the commodities for which air express has been used in the past, the author predicts a tremendous increase in the kinds of products that will be shipped by air and analyzes the factors that will make this possible. One of the main subjects he deals with is lower cost and an established rate structure. Based on the cardinal principles of mileage flown, equipment used, nature of terrain, estimated per cent of pay load capacity, and competition, he points out, this structure should also include "specific commodity" rates lower than the base.

Certain factors favoring air express over other forms of transport are examined. Those are: geography, topography, inventory, warehousing costs, and credits and financing. Also covered, although more briefly, are the subjects of volume business, ground handling, selling the service, and new markets. *Aviation*, December, 1942, pages 244–246, 305, 307, 308, 6 illus.

The War Department Weighs Air Cargo. Robert A. Lovett. In this article the Assistant Secretary of War for Air discusses air cargo's part in winning the war and points out that there has been a great deal of misunderstanding of the transport plane's proper sphere and its possibilities. He states that transport planes today present a picture of limitless possibilities within their proper field and disappointing limitations if they are improperly used. These limitations and possibilities are described. A comparison is drawn between the number of existing four-engined cargo planes and the number of cargo vessels required to move 100,000 long tons of supplies per month to Australia under existing war conditions. *Air Transportation*, December, 1942, pages 16–18.

Air Law

Liability of Air Carriers. G. Lloyd Wilson and Walter S. Anderson. Cases at law are cited to show that the courts have rejected as untenable the contention that the novelty of airplanes and the youth of the air transport industry should exclude operators of commercial aircraft from responsibility under the laws applicable to common carriers governing personal injury and property damage. Air-transport carriers operating for hire on regular schedules over fixed and definite routes have been held to be subject to these laws. The manner in which the aircraft are used is found to determine the character of their operations as common carriers or carriers of other classifications. *The Journal of Air Law and Commerce*, October, 1942, pages 281–301.


fedders
Heat Transfer Specialists Since 1896
HEAT EXCHANGE EQUIPMENT FOR THE AIRCRAFT AND AUTOMOTIVE INDUSTRIES
★
AIR CONDITIONING, HEATING AND REFRIGERATION EQUIPMENT
★
MACHINE GUN BELT LINKS AND CLIPS
Heat Exchanger Division
FEDDERS MANUFACTURING COMPANY, INC., BUFFALO, N. Y.

Air Policy

Whither Next? A discussion of air power policy in the United Nations' offensive. The writer takes up two debatable points: whether the main British-American air effort should be concentrated on bombing German production or in assisting the Army and Navy in European invasion, and whether such an invasion should be from the north or south of Germany. He favors battle support in an invasion via the Mediterranean route. *Flight*, December 3, 1942, pages 613, 614, 1 illus.

Air Power

Air Power Deciding the Battles in Africa. John A. Ward. With emphasis on the part being played by air power, the trends of the war on the European and African fronts are analyzed. The writer shows how, from a strategic standpoint, combined Russian-British-American air power is in a position to batter the Luftwaffe. He also explains why he considers German air forces weakened, dispersed, inferior quantitatively and qualitatively, and on the defensive. A report is given on the approximate numbers and disposition of their aircraft.

Reviewing the battle situation in the Middle East and Mediterranean areas, it is pointed out that should operations be successful there Great Britain and the United States will be in a position to invade the continent at several points. The success of the campaign, it is predicted, would also lead to the reopening of Britain's life line through the Mediterranean and the Suez Canal to India, provide a shorter route for the delivery of supplies to southern Russia and Northern Africa, and constitute an eventual threat to Japan. *Aero Digest*, December, 1942, pages 94–96, 101, 272, 275, 9 illus.

Battles' Baptism Proves Our Planes Best. Hanson W. Baldwin. An analysis of the part played by air power during the past year of war, with an indication of what is to be expected for the coming year. Reviewing the performances of American-built aircraft, the writer considers them superior in most classifications. He names his selections for the best planes of 1942, making his choice from those built by all countries. They include airplanes in the following classes: attack, dive, heavy, and medium bombers; accompanying, interceptor, naval, and night fighters; float, patrol, torpedo, and transport planes. *Skyways*, January, 1943, pages 24, 30, 31, 52, 6 illus.

America's Air Force Attack. Part II. Major Nathaniel F. Silsbee. A survey of U.S. aerial operations on widely scattered fronts with a review of the men in charge of the operations. Among the combat areas noted are Africa, the Middle East sector, and China. American airplanes now in use in different parts of the world are named. The article also comments on the fact that many pioneer air strategists are taking an active and responsible part in U.S. air combat. Generals Arnold, Doolittle, Brett, Brereton, among many others, are some of the men mentioned in this regard. *Airlanes*, December, 1942, pages 11, 30, 33, 4 illus.

A Fading Legend of Terror. John Stearns. Consideration is given to the strength of the German air force. It is admitted that this always has been a mystery, but it is pointed out that the unknown quantity has changed from a positive factor almost to a negative one. Aspects of the German legend of terror are discussed. Reasons for the Luftwaffe's decline are outlined. *U.S. Air Services*, December, 1942, pages 11, 46.

Air Power Is Important, but... Lucien Zacharoff. A picture is presented of Russian air concepts. The writer criticizes impractical air-power theories that ignore other services and states that they are a streamlined revival of theories circulated shortly after World War I in the writings of the Italian General Douhet. He admits, however, that some of the ideas expressed by Douhet have been confirmed. It is emphasized that the Soviets have neither underestimated the importance of air power nor closed their eyes to the limitations of aviation. *Air Trails*, January, 1943, pages 18, 19, 57, 64, 4 illus.

The Quality of U.S. Aircraft. Major Oliver Stewart. Condemning the unfair comparisons to which U.S. planes have been subjected, a Britisher assesses the relative operational merits of British and American aircraft. He attributes much of the criticism and misunderstanding to the fact that the release of information is controlled differently in the two countries. To eliminate this, he advocates a combined British-American procedure for the release of aircraft information. Among the airplanes commented upon are: the Douglas Boston, Lockheed Hudson, Vickers-Armstrong Spitfire, Curtiss Kittyhawk, Boeing Flying Fortress, and the Consolidated Liberator. *Flying*, January, 1943, pages 26, 134, 1 illus.

Luftwaffe Satellites. V. L. Gruberg. An account of the air units from Germany's vassal states that have been reinforcing the Luftwaffe on the Russian front. Brief details are given on the training, equipment, and operations of air squadrons from Roumania, Slovakia, Hungary, and Italy. Organized differently but noted also by the article are the activities of airmen from Spain, Croatia, and Finland. The writer's opinion regarding the help received by the Luftwaffe from its allies is that their resources are poor, their training and equipment are second rate, and about the only assistance they have rendered the Germans is to cause the Russian air force to divert some attention to them. *Flight*, November 12, 1942, pages 527–529, 6 illus.

The War in the Air. This article represents a general discussion of air warfare with regard to how it is being carried on by the United Nations in the various war theaters, what has been accomplished, and what may be accomplished in the future. *Aircraft*, October, 1942, pages 18–20, 5 illus.

Russia's Fighter Command. Major Gen. Mikhail M. Gromov. A Russian air force general explains the role of the fighter command in Russian air strategy and describes the work of the fighters in both offensive and defensive operations. Emphasis is placed upon the importance of good organization and a smoothly functioning system of communications. The use of "springboard landing fields" and the direction of fighting by wireless from the ground are two phases of Russian Fighter Command tactics which are discussed at length. *Flying*, January, 1943, pages 27, 28, 146, 147, 3 illus.

Japan in the Air. The growth of Japanese air power is discussed in this concluding installment of an article that described the work and results of the British Air Mission to Japan in 1921. Although the purpose of the Mission was to help build up Japanese naval air power, this installment covers the question of that country's military and civil aviation. It gives details on several Japanese airdromes, not included in the preceding installment. It also considers Japanese-built airplanes, with particular attention to the products of the Mitsubishi Company. In conclusion, the writer's evaluation of Japanese economic problems and national characteristics would seem to throw some light upon the tenacity with which they will fight this war. *The Aeroplane*, November 6, 1942, pages 535–537, 8 illus.

Seat-of-the-Pants Strategy. Jack Knight. An experienced pilot gives his opinion of the progress United States air power is making. He reports on America's aircraft produc-

tion, airplanes, and pilots. His estimate of all three are summed up by two words: "the best." The lack of a sufficient number of experienced pilots is designated as America's greatest bottleneck at present. *Flying*, January, 1943, pages 41, 100, 103, 104, 2 illus.

Air Transport

Air vs. Rail and Water Transport in the Postwar World. W. A. Patterson. Abstracts from a paper on the subject of air versus rail and water transport after the war are presented. While convinced that the airplane will occupy an important place in the scheme of postwar transport, the writer feels that overenthusiastic predictions being made with regard to air transport are harmful. He presents relative figures on the cost of shipping cargo by air, rail, and water and analyzes the subject of surface versus air transportation with consideration to possible future developments and improvements. *Automotive and Aviation Industries*, December 15, 1942, pages 17–19, 66, 68, 3 illus.; "Keep Air Cargo's Feet on the Ground," *Air Transportation*, December, 1942, pages 9–15, 1 illus.; "Post-War Planes Will Augment Railroads and Steamship Lines," *Contact*, January, 1943, pages 4, 13, 15, 17, 1 illus.

Bigger and Better Air Transports. In this article the writer emphasizes the need for large aerial supply fleets to furnish the United Nations with the vast quantities of men and material needed when air armadas attack in cooperation with mechanized forces. To show that this need is being realized by leaders in the fields of design, publishing, military operation, and business, extracts from some of their statements are quoted. *Aircraft*, October, 1942, pages 10–13, 10 illus.

The Flying Dutchmen Carry On with Cargo. Activities of the KLM, Royal Dutch Air Lines, founded in 1919, are traced up to the present. *Air Transportation*, December, 1942, pages 5–8, 4 illus.

Total Planning Can Assure Airline Future. E. J. Foley. The writer considers a program for the future progress of air transport and emphasizes the importance of developing an integral plan for the future. It is stated that the keystone of both efficient performance and the planning for it is the airplane itself, but other factors include the operating organization and its policies, servicing and handling area, equipment and methods, ground and air operating areas, and facilities and techniques. Problems connected with the improvement of air-line operation are discussed in considerable detail and an expandable solution is suggested. *American Aviation*, December 15, 1942, pages 46, 52, 1 illus.

The Aerial Mercantile Marine. John A. Sizer. The writer advocates the use of flying boats for transoceanic air transport. Two chief reasons are given in support of his contention that they are more efficient for this specialized task than landplanes: First, flying boats can take off again if compelled to alight on the water, whereas landplanes cannot; second, seaplanes do not require extensive land bases.

Tracing the history of transoceanic flights made by flying boats, the article also lists those that are currently used. It discusses the general design requirements and propeller problems. In conclusion, specifications of three existing projects for advanced flying-boat types are listed. These particulars refer to the Rumpler design, the Sikorsky S-47, and the Short six-engined flying boat.

The article includes tabulated data on typical long-range flying boats. American, British, French, and German flying boats are listed. *Flight*, November 19, 1942, pages 547–550, 9 illus.

Clippers Playing Vital Role in War Effort. Richard L. Singley. A brief article commenting on the part clippers are playing in the war effort. Operations of Pan American Airways and of American Export Lines are mentioned. *The Airpost Journal*, December, 1942, pages 80, 81, 1 illus.

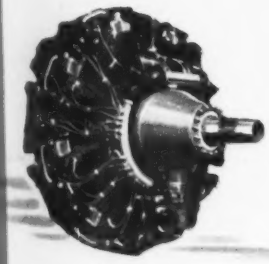
'Airmada.' Col. Edward S. Evans. An industrialist pictures the time when aviation will be universally accepted for a multiplicity of purposes. His predictions concern gliders, cargo planes, and helicopters. He also offers suggestions on how a large supply of gliders could be made immediately available and discusses the question of size relative to transports. In conclusion, he states his opinion that the war can be won by an "airmada" of flying freighters. *Flying*, January, 1943, pages 25, 124, 126, 2 illus.

Sources of Feeder Airline Business Part III: Air Cargo. John H. Frederick and William J. Hudson. The third article in this series gives attention to the potentialities of the business of carrying express and freight by air. It is indicated that air-cargo business has been neglected in the past because air-mail contracts produced the necessary revenue to enable the air lines to develop passenger volume, and there was no pressing need for expansion into the new and highly competitive field of air cargo. An investigation of these possibilities is held to be urgently needed, and suggestions are made for pursuing such a study. An analysis is presented of air express shipments, with tabulated data covering quantities, commodity groups, geographic distributions, and other classifications. An evaluation of the potential volumes of various kinds of freight is accompanied by figures on total business volume in different territories. Consideration is also given to the problems of airports and the types of aircraft suitable for the work. *The Journal of Air Law and Commerce*, October, 1942, pages 302–320.

Skyways to Mexico. Margaret Hannon. Announcing the inauguration of American Airlines routes into Mexico, this article explains the importance of this new link in North American air communications. A report is given on the inauguration ceremonies that took place on September 5, 1942. Descriptive details are also included on the airport at Monterrey. *Airlanes*, December, 1942, pages 19, 37, 3 illus.

Around the Windwards. Francis J. Field. The writer describes a pioneer mail flight made in 1932 by the owner of the only private airplane in the British West Indies, who

The new giant Lockheed Constellation being groomed during tests that preceded its first flight. It is powered with four Wright Cyclone 18 engines, which are the most powerful service aircraft engines in the world. These are air-cooled radial engines of the powerful 2,000-hp. series. (*See* "From the Industry.")



THE giant telescope and the aircraft engine — both are precision instruments to conquer space. The telescope merely shortens visual distance, but the twofold power of the aircraft engine telescopes time as well as physical distance to broaden man's sphere of action. For the great transports which speed the ever increasing tonnage of the air, Wright provides the power.

WRIGHT *Aircraft Engines*

POWER THE TONNAGE OF THE AIR

Simple guard for power drills improves operation

Information supplied by an Industrial Publication

Safety in small things as well as great is an excellent policy for manufacturing plants today. Adding safety devices to small power driven hand tools has the same results as the same procedure on heavier machines. Operators can work better because their attention is undivided.

That was the idea behind a guard for power driven hand drills devised by a worker in an airplane factory. He noticed that hole spotters sometimes got pinched fingers when the drill suddenly punched through the work.

The guard is very simple. It consists of a steel sleeve set into the drill chuck surrounding the shank of the drill bit. It is easy to attach, and it could be made from scrap tubing, or bar stock cutoffs with a minimum of machining.

In operation, when the drill goes through, the guard brings up against the work, and stops forward motion of the tool. It is long enough so that the operator's fingers cannot be caught between the work and the drill body. As a result slowing down caused by the operator's natural tendency to flinch is eliminated.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE BRIQUETTES • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

volunteered to carry the mails when on a week-end holiday trip. *The Airpost Journal*, December, 1942, pages 100, 101.

Airplane Descriptions

The De Havilland Bomber Family. This article traces the evolution of the de Havilland bomber. It reviews briefly the outstanding features of the various de Havilland airplanes from the first World War, through peacetime, and in this war. A table is appended which lists the engine, type, purpose, and date of prototype of the following de Havilland series numbers: D.H. 3, 4, 9, 9a, 10, 10a, 11, 14, 15, and 27 Derby. The same data are given for the D.H. 42 Dingo, 42a Dormouse, 42b, 56 Hyena, 65a Hound, 65b Hound, 84 Dragon, 89 Rapide, and 98 Mosquito. *The Aeroplane*, November 6, 1942, page 540.

Anson V, Molded Plywood, Product of Canadian Genius. Information is given on the Canadian-built Anson V, which will incorporate molded plywood construction. This twin-engined trainer will have a fuselage built under the Vidal process. The article also explains the basic principles of the process. *Canadian Aviation*, December, 1942, pages 96, 98, 1 illus.

The Bücker Bü 181. A brief description of the Luftwaffe's latest training plane, the Bü 181 Bestmann. Figures are given on its performance, weights, dimensions, and engine. *The Aeroplane*, November 6, 1942, page 541.

Airports

Control Tower. Gerald Crowley. How standardization of control tower procedures and practices by the C.A.A. has made possible the handling of vastly increased airport activity is reported. The advantages of having the C.A.A. operate the towers and the innovations for which the Administration has been responsible since assuming charge of those on major airports are cited. The article also explains the purpose and operation of control towers. *Flying*, January, 1943, pages 67, 126, 128, 2 illus.

Armament

Fighter Armament. The first of a series of articles reviewing the various types of guns and their installations in fighters of the Allied and Axis air forces. Beginning with an account of the progress made since 1914–1918, this installment examines modern fixed-gun installations and the problems with which designers must deal. Particulars are given on evolution of cannon, their caliber measurements and velocities, the adoption of guns with greater hitting power, and 75-mm. weapons. The trend of future development with regard to armament is also predicted. *Flight*, November 12, 1942, pages 518–522, 12 illus.

The Aerial Bomb. Col. S. R. Stribling. A detailed study of the properties, action, and effects of aerial bombs. The science of bomb projection is analyzed and the principles of both high-explosive and chemical bombs are explained. In the high-explosive class, demolition and fragmentation bombs are covered; in the chemical classification, bombs loaded with any type of chemical—incendiary, smoke, gas, etc.—are discussed. Also presented is a tabulated comparison of European and American high-explosive bombs. *Flying*, January, 1943, pages 38–40, 112, 114, 8 illus.

Development of British Aircraft Armament. A detailed report of the offensive and defensive armament now in use on British bombers and fighters. Armament equipments of specific British planes are described and comparison is made with that of German aircraft. In the bomber class attention is particularly directed to the fire power and lesser vulnerability of heavy bombers, the evolution of the fighter bomber, and the use of power-operated turrets. Guns and gun arrangements are examined.

In the fighter class the maintenance of British Supremacy is partially accounted for by the substitution of 0.303 machine guns with 20-mm. cannon, using high-explosive, incendiary, or armor-piercing and high-explosive ammunition. The applications of 0.303 Browning aircraft machine guns and the use of an electropneumatic mechanism for the firing operation of guns are also discussed. *Aero Digest*, December, 1942, pages 179, 180, 183, 287, 288, 9 illus.

Fighter Armament—Part II. Part two of a series of articles on the guns and gun installations in the fighter aircraft of both Allied and Axis nations. Various gun installations and combinations are illustrated in this installment. Ammunition feed problems are considered and different conceptions of "ideal" armament are discussed. The following topics are particularly emphasized: Russian oil research, cannon feeds, triggers and sights, the multigun conception firepower development, Hispano operation, and the 0.303 Browning. *Flight*, November 19, 1942, pages 553–557, 9 illus.

Battle of the Bullets. W. S. Shackleton. A rationalization of the proposition that projectiles fired from the rear of a bomber have a ballistic advantage over those fired from the fighter pursuing it. The advantages gained by firing downstream instead of upstream are explained. A corollary argument advanced by the article is with regard to the superiority of the 0.5-in. caliber bullet over the 0.303-in. *The Aeroplane*, November 27, 1942, pages 622–625, 11 illus.

Fighter Armament—Part III. The final article of a series describing the types of guns employed and their installations in the fighter aircraft of the Allied and Axis nations. This installment covers the armament of German, Italian, American, Russian, Japanese, and French fighters. It concludes with a forecast of future trends. The writer predicts that powerful single-engined fighters will carry any of the following combinations: four or six 20-mm. guns; eight or ten 0.5-in. guns; two 30-mm. or over guns; two 20-mm. plus four or six 0.51 guns. For twin-engined fighters of double the power he predicts that, although they will not carry armament twice as heavy, their loads will be about 50 per cent more than that of the single-engined fighters.

In the discussion on German installations, their preference for encased wire control is indicated. Details are particularly noted on electric firing and the system of ducting hot air to ammunition chutes. *Flight*, November 26, 1942, pages 579–584, 18 illus.

Avigation

Little Tin Guy! Lt. Allen Rankin. A narrative of how a pilot and three aviation cadets were brought safely home shows the importance of the avigator's job. It also shows how instruments are utilized to map an airplane's course. *Skyways*, January, 1943, pages 20, 21, 69, 78, 6 illus.

Bubble Sextant Acceleration Errors. Charles Williams. Using a minimum of mathematics, the writer describes the nature of errors occurring with the bubble sextant and explains the reasons why they arise. *Aeronautics*, December, 1942, pages 42, 43, 3 illus.

Blind Flying

Of Instruments and Things. Robert N. Buch. Some advice is offered on the actual use of the turn indicator, the rate-of-climb indicator, and the artificial horizon in specific flight maneuvers. The point stressed is that in using instruments a pilot must have more than just the knowledge of how to read them; he must have experience, imagination, and the faculty called "feel." Since the article is concerned mainly with smooth flying by instruments, the maneuvers discussed are chiefly small

CHECKING IMPACT STRENGTH OF LUMARITH

REG. U. S. PAT. OFF.

PLASTICS FOR U. S. AIRCRAFT

The outstanding impact strength of Aero-Quality Lumarith plastics is made visible to the human eye by the Gjon Mili repetitive flash photograph. The 12-lb. iron ball (4½″ in diameter) is dropped from a height of 10 feet on ⅛″ thick sheet of transparent Aero-Quality Lumarith plastic. The 12-lb. ball is shown hitting the Lumarith and bouncing in the air, leaving the sheet intact.

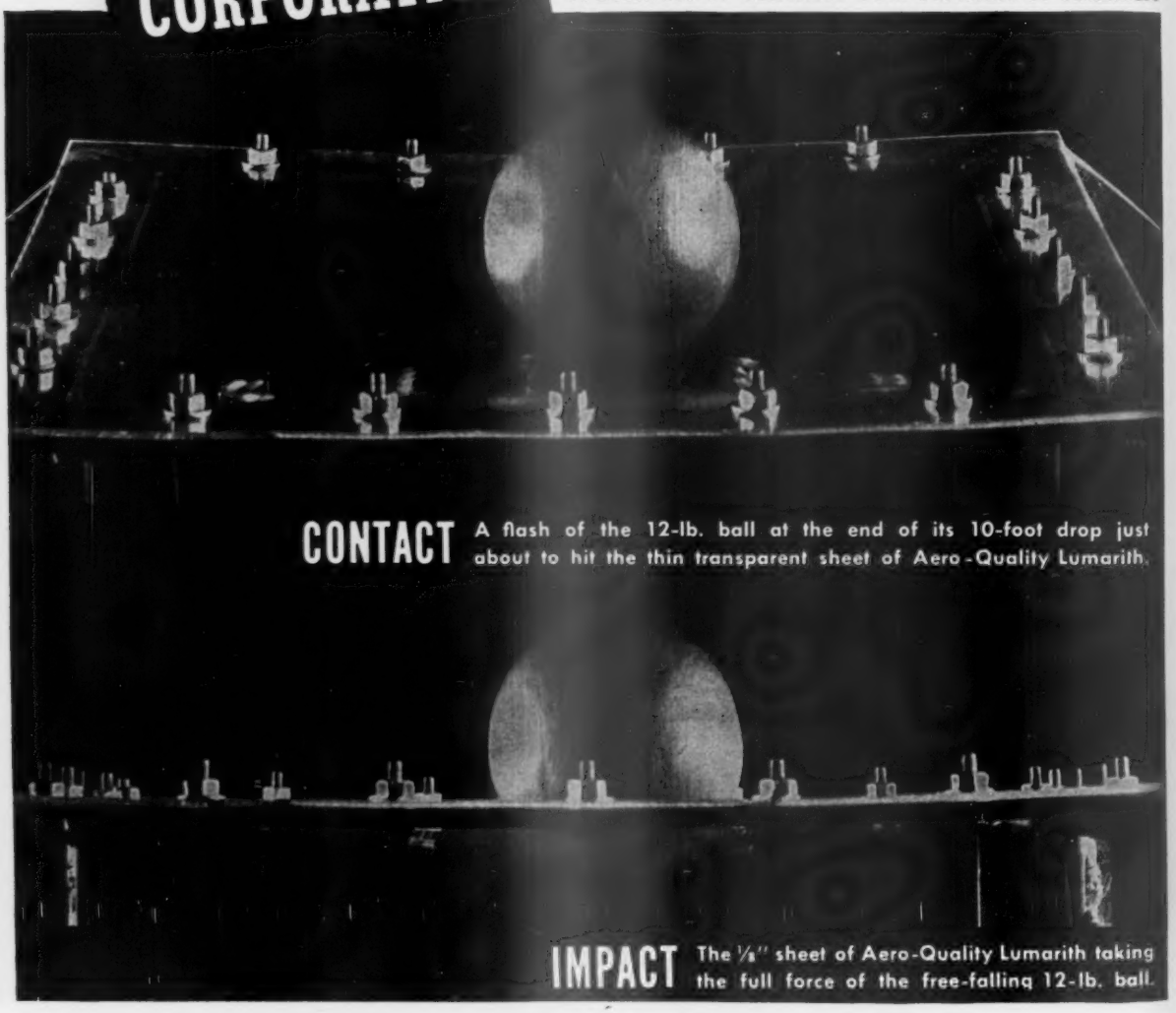
Transparent Lumarith sheets are cold-formed or heat-formed to make the windows of cockpits and turrets for many United Nations planes and gliders. Aero-Quality Lumarith protects flyers against severe sunburn.

Celanese Celluloid Corporation, 180 Madison Ave., New York City, a division of Celanese Corporation of America. *Reps.: Dayton, Cleveland, Chicago, St. Louis, Detroit, San Francisco, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.*

CELANESE CELLULOID CORPORATION

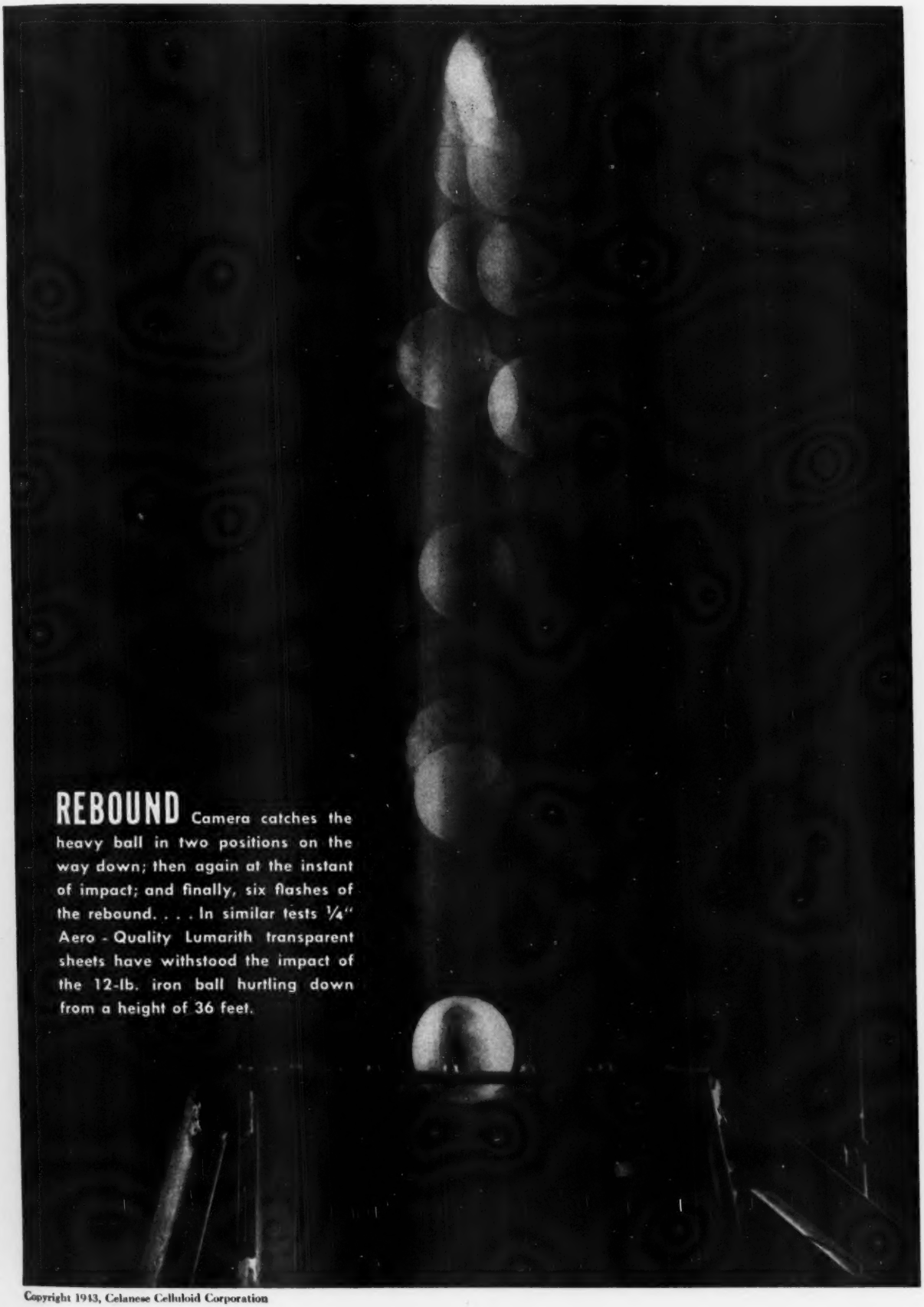
The First Name in Plastics

A DIVISION OF CELANESE CORPORATION OF AMERICA



CONTACT A flash of the 12-lb. ball at the end of its 10-foot drop just about to hit the thin transparent sheet of Aero-Quality Lumarith.

IMPACT The ⅛″ sheet of Aero-Quality Lumarith taking the full force of the free-falling 12-lb. ball.



REBOUND Camera catches the heavy ball in two positions on the way down; then again at the instant of impact; and finally, six flashes of the rebound. . . . In similar tests ¼" Aero - Quality Lumarith transparent sheets have withstood the impact of the 12-lb. iron ball hurtling down from a height of 36 feet.

Copyright 1943, Celanese Celluloid Corporation

Dunco High Efficiency
RELAYS FOR SMALL-SPACE USE

It's much more of a trick to make a fine, accurate wrist watch than it is to produce an alarm clock. Similarly, the task of making really dependable and durable midget relays is one that calls for the best that a specialized manufacturer, already accustomed to high standards of quality, can give it—and here Struthers Dunn engineering excels.

As a result, Dunco Midget Relays have established new standards of performance in a wide variety of applications where space is at a premium, and where dependability under exacting conditions of use is essential. They are produced in dozens of standard and special types and sizes for almost any requirement. Dunco Midgets are Underwriter approved.

OTHER DUNCO RELAY-TIMER TYPES

30 ampere — Sensitive — Instrument Controlled — Low Voltage, Heavy Current, D. C. — Mechanical Latch-in (Electrical Reset) — Mercury Contact—Telephone Auxiliary—Lamp Controlling — Polarized — Overload — Timing — Sequence, Ratchet Type—Motor Reversing, and many others.

Write for the New Dunco Catalog and Relay Data Book.

26 Dunco representatives located in every major war equipment manufacturing center throughout the U. S. and Canada are trained to help you in all problems of relay selection and use. Write or wire for address of your nearest representative.

STRUTHERS DUNN, Inc.

1321 ARCH STREET PHILADELPHIA, PA.

turns, banks, and climbs. *Air Facts*, January, 1943, pages 7–15, 1 illus.

Business and Finance

Aviation's Future Trends. Selig Altschul. An examination of the outlook for companies in the aviation industry explains recent action of the stocks and analyzes the sources of earnings, with particular reference to the air-transport companies. It is stated that future earnings are probably being discounted, and the opinion is expressed that the air lines will experience a major growth trend, with a heavy expansion in business volume. A comparison is drawn with the electric power industry to show that earnings growth does not always follow expansion in volume, but it is indicated that technologic improvements should permit economies in operation which would enable the realization of earnings even under rate reductions. Attention is directed to the competitive aspects of the field in which the air lines will operate, since the position of the railroads is being improved by their present large earnings, their finances are strong, and their employees exert influence. It is concluded that these problems will call for ingenuity on the part of the managements of the air lines. *Aviation*, December, 1942, pages 249, 302, 305.

Airlines Are Big Business. Robert S. Morton. An analysis of the factors that account for the increased earnings of the air lines during 1942. Supporting the statement that the income of the air-transport industry has been greater for that year than any other in its existence, the following reasons are given: complete exploitation of existing equipment, improved maintenance procedures, better load factors, curtailed operating expenses, reduced depreciation charges, abolishment of special discounts, and increased revenue from air-express shipments. Credited with having contributed materially to 1942 profits were operations conducted, under contract, by the air lines for the War Department and other military services. These include not only transportation activities but training, overhaul, etc.

Part of the article is devoted to a discussion of the mail rates. It also contains three tables: one lists the net profits of the individual air lines for 1939, 1940, 1941, and 1942; the second lists the amounts of dividends paid for those years; and the third tabulates the proceeds from aircraft sold by the domestic air lines. *Flying*, January, 1943, pages 47, 48, 76, 79, 1 illus.

Civil Air Defense

Deep Tunnel Air Raid Shelters. A three-part article is presented on the construction and arrangement of eight air-raid shelters built in London. These deep tunnels were built to shelter the large number of people who took shelter nightly in London tube railway stations. It is explained that each shelter consists of two tunnels about 1,400 ft. in length, parallel to each other. The tunnels have shelter accommodations at two levels. Information is given on the lighting equipment, the arrangement of bunks, and how the tunnels are constructed and ventilated. *The Engineer*, November 27, 1942, 445–448, 4 illus.; December 4, 1942, pages 456–458, 4 illus.; December 11, 1942, pages 472–474, 4 illus.

El Peligro Aereo Lo Que Las Poblaciones Civiles Deben Saber (What the Public Should Know About Air Attacks). The second of a series of articles which deals with passive air defense. The main purpose of passive air defense is said to be: (1) to avoid casualties among the civil population or to reduce them to the lowest possible minimum; (2) to take precautions that material damages are limited as much as possible; (3) to maintain public morale by liberal information on current activities, as well as war news; (4) to maintain proper functioning of public services in order to assure uninterrupted progress in war industries as well as private industry. Passive defense consists of preventive and defensive measures. Preventive measures are defined as: removal of the civil population and periodic evacuation of people who do indispensable work in the city. Camouflage, gas masks, alarms, dim-outs, and blackouts are discussed. Defensive measures are listed as including such safety measures as vigilance, police protection, detection of chemicals, disposal of unexploded bombs and first aid and salvage measures such as fire fighting, removal of obstacles, sanitary service, decontamination, repairs of water, light, gas and telephone services. Auxiliary services consist of welfare work and transportation of people who have lost their homes. *Revista de la Fuerza Aerea*, July, August, September, 1942, pages 5–11.

Civilian Incendiary Bomb Extinguisher. A description is presented of a stirrup pump for extinguishing incendiary bombs. Details of the design are furnished. The equipment is said to have a capacity of 4 gal. of water and includes a 10-ft. hose provided with a nozzle that shoots a stream of water for a distance up to 50 ft. *Modern Plastics*, December, 1942, pages 73–76, 8 illus.

Civil Aviation

Civil Air Patrol Completes Year of Service. Major Earle L. Johnson. The National Commander of the Civil Air Patrol reports on its activities during the first year of its existence. Depicting the growth of the organization, he tells of the courier and coastal submarine patrol services it has rendered. He also describes its inauguration, personnel, officers, equipment, training courses, and junior organization. *Aviation*, December, 1942, pages 250–252, 7 illus.

Accidentes de Aviacion (Airplane Accidents). Raul Yazigi. A medical study of airplane accidents and their causes. A statistical analysis of several hundred cases shows the following percentages of causes: disobedience of rules and regulations, 3 per cent; errors of judgment, 25 per cent; carelessness or negligence, 32 per cent; technical defects, 40 per cent. The violations of the first group show not only a disrespect toward the authorities and a lack of sense of responsibility but also an attitude of indifference toward discipline, which tendency may have been evident since childhood or adolescence. The study of these stages of life of the candidates is therefore suggested. As to the other groups, a psychologic and physical test of the pilot may reveal illuminating data, while in the last group inexperience may play an important part. *Revista de la Fuerza Aerea*, July, August, September, 1942, pages 38–41.

Control Equipment

The Dornier Drogue Harpoon Diving Brake. A brief description is presented of a new umbrella-type diving brake recently applied to Germany's Dornier 217E dive bomber. A comparison is drawn between this latest approach to airplane deceleration control and other types of diving brakes. An advantage claimed for the new tail-type diving brake or drogue is that the loss of any one or several of its members would not set up turbulences great enough to affect the behavior of the airplane. *Air Tech*, November, 1942, page 6, 6 illus.

Design

Designing for Easy Maintenance. J. A. Knox and J. J. Boericke. Two features of the Fleetwings BT-12, which has been designed specifically to afford easy maintenance and service are given. The first is the incor-

poration of airplane parts that are inherently service-free. Illustrating this characteristic are the BT-12's oilless bearings and its fluorescently lighted instrument panel. The second is the use of easily removable units both in the interior and exterior of the plane, exemplified by the large, readily removable sections of fairing on the fuselage. In addition to these, several other features, advantageous for maintenance purposes, are mentioned. Drawings of the parts supplement the descriptions. *Aviation*, December, 1942, pages 108–112, 6 illus.

As a Test Pilot Sees It. J. D. Clark. To overcome handicaps of maneuverability and climb, a fighter is envisioned which incorporates some radical changes in design and basic factors. This would be a full-cantilever, mid-wing type with a low aspect ratio. Powered by two flat-type supercharged engines incased in the wing, it would have three-bladed tractor-type propellers rotating close to the leading edge of the laminar-flow wing. In this proposed design the pilot would lie flat on the wing's upper surface, with the armament housed in the bottom segment of the fuselage. This design, it is claimed, would result in a wing loading of just about half that of present fighters, about double the power loading, and greatly improved climb. Other advantages and specifications are given, but the problem of putting this design on a practical basis is left to the engineers. *Air Facts*, January, 1943, pages 20–24.

The Design and Operation of Nose Wheel Shimmy Dampers. Gervase M. Magrum. Beginning with quotations from N.A.C.A. T.R. No. 686 and from other sources concerning the stability of castering wheels for aircraft tricycle landing gears, the writer presents a description of two types of hydraulic damper: the piston type and the vane type. A detailed survey of the latter type is given. Three methods of mounting "shimmy" dampers are outlined: (1) outboard, (2) integral built-in, and (3) integral independent.

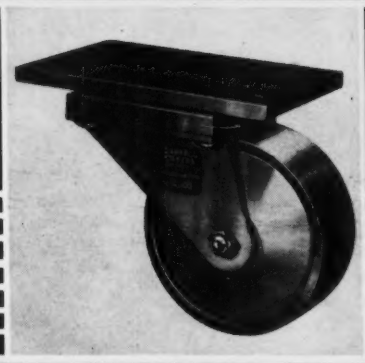
The determination of the proper size of damper is discussed. Analysis of damper characteristics develops a theory that a certain amount of shimmy is inherent and is not harmful to the airplane. An alternate theory is advanced in case the first theory is rejected or proved false. This recognizes a large angular displacement of the nose wheel. The writer advocates the use of a damper of larger displacement than would be necessary, with all linkages of the landing gear in perfect condition, to take care of any loose joints or excessive deflections. It is concluded that the method of installation should be as direct as the geometry of the gear permits. The vane type is favored because it is a complete assembly in itself and requires a minimum amount of servicing. *Aero Digest*, December, 1942, pages 142, 146, 148, 151, 275, 9 illus.

The Job of the Aero Engineer. Sidney Packard. The many steps in the designing of a modern airplane as they must be carried out by the engineering staff are outlined. Engineering problems of design and production are described. *Air-Age*, February, 1943, pages 40–43, 64, 6 illus.

Three-Views Come to Life. Philip J. Lawson. This article tells how students of advertising design at Pratt Institute are using three-way airplane drawings to develop perspective drawings that are used as a basis for illustrative pictures. *Air Trails*, January, 1943, pages 20, 21, 68, 69, 7 illus.

Eliminating Unnecessary Weight in Aircraft Structures. Martin Boe. The purpose of the article is mainly to show where unnecessary weight can be eliminated in airplane design and to point out other ramifications of weight saving and their effect on airplane performance. The writer urges that the scope of weight control be extended to every component of the air-

DARNELL
CASTERS & WHEELS



Darnell Double Ball-Bearing Casters and E-Z-Roll wheels reduce floor wear to a minimum, lengthen the life of equipment and increase the efficiency of employees—Write for 192 page Darnell Caster and Wheel Manual.

DARNELL CORP. LTD., 60 WALKER ST., NEW YORK, N. Y.
LONG BEACH, CALIFORNIA, 36 N. CLINTON, CHICAGO, ILL.

SPEED RANKS FIRST IN WARTIME CLEANING

Heat Treat Film Removed From Aluminum Parts *QUICKLY!*

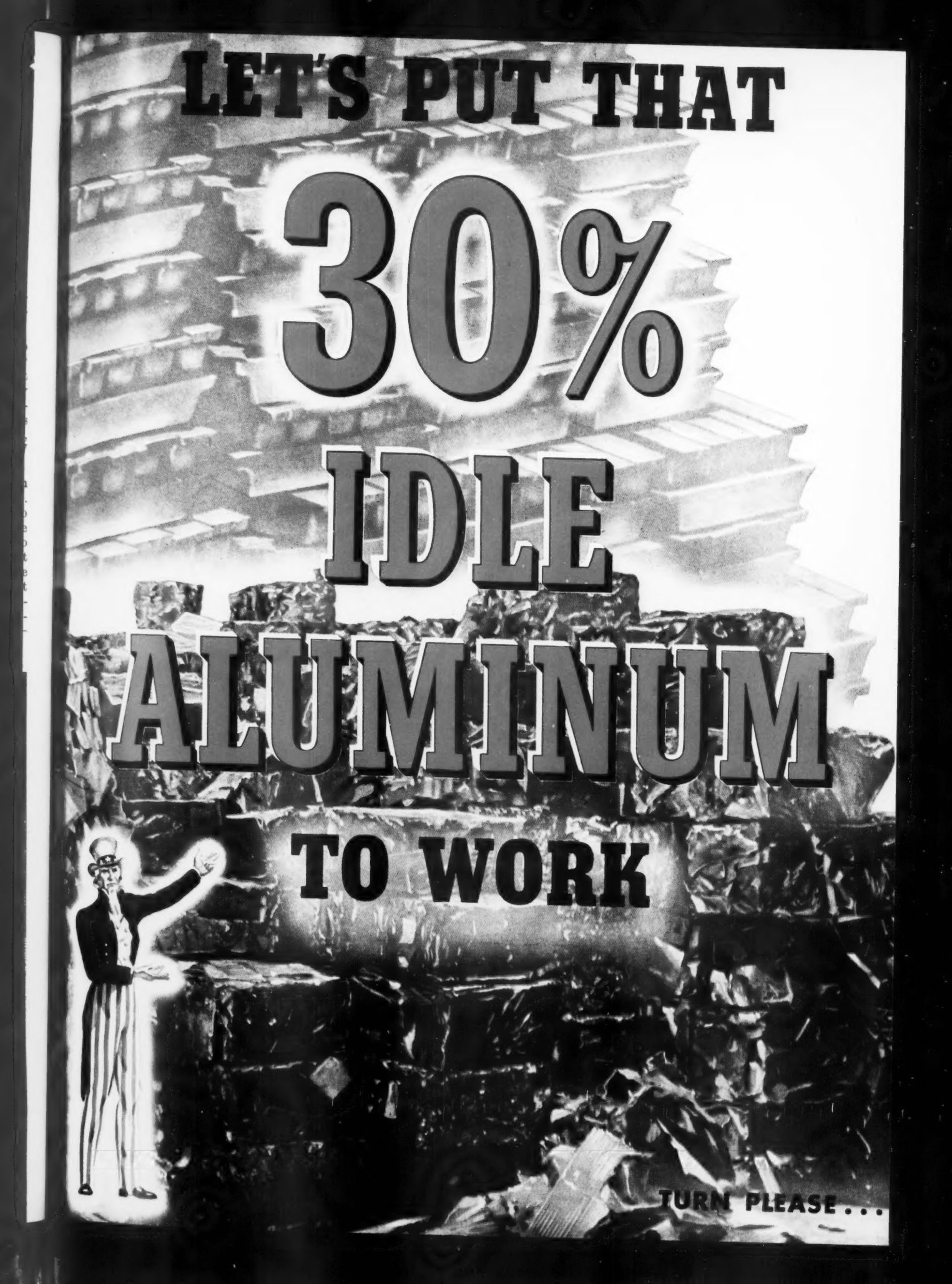
By immersing heat treated aluminum sheets and parts in solution of Oakite Compound No. 84-A as directed by our nearby Technical Service Representative, you can now easily remove the discoloration that follows heat treating ... and do it in a fraction of the time formerly required! Method is safe ... low in cost ... and restores original finish of parts. Details FREE to executives making request on their business letterhead.

OAKITE PRODUCTS, INC., 27 Thames Street, NEW YORK

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE
Specialized
CLEANING

Buy Bonds for Victory


LET'S PUT THAT
30%
IDLE
ALUMINUM
TO WORK
TURN PLEASE . . .

REYNOLDS AIRCRAFT PARTS DIVISION
Specializing in SHEARING, BLANKING and ROUTING
Solves the Industry's Problems in
Every ounce of allocated metal is in the finished part, not in scrap. The aircraft builder can use all the metal he receives, and without delay.
Thousands of pounds of aircraft skins are now being sheared on this type of equipment in Reynolds Aircraft Parts Division.
Routing and drilling are among the principal Reynolds' parts-making operations. Capacity for this work is already large, and is constantly expanding.
Every piece is Army-Navy inspected for chemical and physical properties, size, gauge, hardness and surface.
Thirteen hundred ton Hamilton Press, shown during installation. Reynolds offers over two million pounds of blanking capacity to the Aircraft Industry today.
Scrap from shearing, routing and blanking is remelted at Reynolds' plants immediately, without costly loss of time, re-shipment between cities, or diversion of valuable metal.

SCRAP UTILIZATION

... Fully 30% of all aluminum sheet is lost in making aircraft parts. Reynolds puts this scrap metal back into use at once, at the aluminum source—eliminating months of storage, tedious segregation and handling, costly shipping, labor, and plant space. The Nation needs these extra millions of pounds of aluminum now!

MANPOWER

... Under the Reynolds' Plan, every piece of aluminum the plane builder receives is in finished parts, ready for assembly. Aircraft plants need not tie up their own precious skilled labor making dies and fabricating individual parts. Reynolds is prepared now to handle this work, leaving the plane builders free to build planes!

TOOLMAKING

... Parts to supply several aircraft plants building similar planes can be produced by Reynolds Aircraft Parts Division from a single set of tools. Wasteful duplication of both labor and materials in the critical tool-making field is eliminated.

TRANSPORTATION

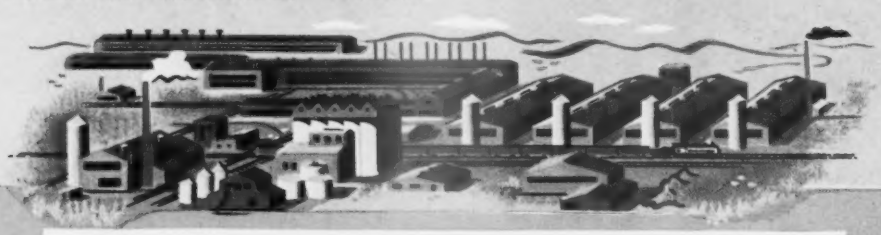
... Fabricating parts and handling scrap at the aluminum source releases for other war production duties the thousands of freight cars formerly required to haul scrap metal back from aircraft plants. Using Reynolds' parts-making facilities helps break the transportation bottleneck!

TURN PLEASE . . .

"HISTORY"

France, England and America ignored for five years the sensational increase in production of Aluminum Metal by Germany and her allies. This tragic failure doomed France and tragically threatened England. Uncle Sam at last placed his fighting fist squarely around America's greatest bottleneck — aluminum. Of course, the spirit of defeat cried aloud "It's not needed." Timid little devils of fear thought a thousand petty reasons why it should not be attempted. Uncle Sam has often laughed at timidity. He has learned that the spirit of offense is never conquered, that the fighter with the initiative never loses. He reasoned that this is a light metal war. That it will be won or lost in the air. To Uncle Sam nothing else mattered.

Today there remains still another bottleneck to be broken in the aluminum industry — that 30% of idle metal tied up for months at a time in the form of scrap in transit, at plane plants and in junk yards throughout the nation, awaiting re-processing. This priceless aluminum is thus diverted from plane production at the most critical moment in our history. With its newly expanded Aircraft Parts Division, Reynolds Metals Company offers to aircraft manufacturers everywhere a way to smash this bottleneck — *NOW!*



AIRCRAFT PARTS DIVISION

LOUISVILLE, KENTUCKY

EXECUTIVE OFFICES: RICHMOND, VA. and LOUISVILLE, KY.

Sales Offices in Principal Cities

REYNOLDS FOR WAR TODAY · REYNOLDS ALUMINUM · FOR PEACE TOMORROW **METALS C**

craft and states that the possibilities in this direction have not been fully capitalized, being effective on only about 40 per cent of the gross weight. Analysis shows that of the remainder 20 per cent is disposable load and the remaining 40 per cent is attributed to a variety of equipment, the greatest weight deficiency occurring within the latter group. Attention is given to matters of excessive weight and strength, comparisons being made with weights of accessories on German fighter airplanes. Weight savings in domestic accessories are cited. Consideration is given to design problems, tactical problems, and effects of weight on performance, with reference to commercial planes as well as warplanes. Numerous points are brought out concerning the benefits of converting weight saved into increased fire power, range, pay load, and other factors. *Aero Digest*, December, 1942, pages 154, 157, 158, 1 illus.

Selecting the Airfoil Section. Raoul J. Hoffman. In a consideration of the problems confronting the aircraft designer, suggestions are made for the simplification of the procedure in investigating the forces resulting from deflected airflow and the circulation around the wing. The writer explains a series of sketches and charts, beginning with the derivation of the mean line and its application for laying out an airfoil section. The creation of the N.A.C.A. four-digit sections is related, as well as the five-digit sections and other families of sections which have been tested. Methods of testing airfoils in wind tunnels are reviewed. Comparisons are made between airfoils of various characteristics. It is shown that the selection of the camber of a section is not so simple as may appear from the charts used and that stability, structural weight, production and repair facilities, and available stowing space play an important part in the decision. *Flying*, January, 1943, pages 66, 143, 145, 9 illus.

Comfortization of Military Aircraft. Part 5. Albert A. Arnhym. Concluding article of a series dealing with military comfort accessories, the problems connected with them, and suggestions on how to meet these problems. This installment summarizes the recommendations made in previous installments regarding the preliminary planning of comfortization and its coordination with the design of the airplane itself. It emphasizes the fact that combat comfort is attained not so much by special devices or equipment as by design considerations that take into account the physical requirements and limitations of the human body. It then goes on to discuss several phases of comfortizing military aircraft. Topics particularized are: seating and resting, lighting and sight conditioning, food, lavatory facilities, and ease of motion. *Aero Digest*, December, 1942, pages 196, 198, 200, 203, 204, 208, 283, 284, 10 illus.

Mechanical Engineers Discuss Diesel Engines — Aircraft — Materials. P. M. Heldt. Abstracts are presented from aeronautical papers read at the annual meeting of the American Society of Mechanical Engineers. The papers read included one on anti-friction bearing development in aviation, by Thomas Barish, and one by P. H. Schweitzer in which he proposes a new definition of the term "volumetric efficiency." Other papers presented were those by Frederick A. Hiersch covering a proposed correction factor for the efficiency of Roots-type blowers, a paper by G. P. Toews on the possibilities of carburetor-type aircraft engines; one by Capt. Baxter C. Madden, of the Army Air Forces, on rubber mountings to lessen engine-vibration effects; another by N. J. Hoff on edge reinforcements for cut-outs in monocoques; and a paper by W. J. King on factors affecting readings of thermocouples in gas streams of 1,200° to 2,000°F. *Automotive and Aviation Industries*, January, 1943, pages 39, 40, 56, 58, 60, 62, 3 illus.

Aircraft Noise. D. C. Greenwood. In the first section of a two-part article, an outline is given of the problem of noise reduction in aircraft and the steps to be taken in noise proofing. In peacetime commercial aircraft the reduction of noise is a matter of passenger comfort and luxury, but in war aircraft questions of the efficiency and alertness of crew members are involved. The writer explains the nature of sound, frequency, pitch, and velocity and defines the threshold of hearing. A discussion follows on available types of noise meters and their use in analyzing aircraft noises. *Flight*, December 3, 1942, pages 615, 616, 3 illus.

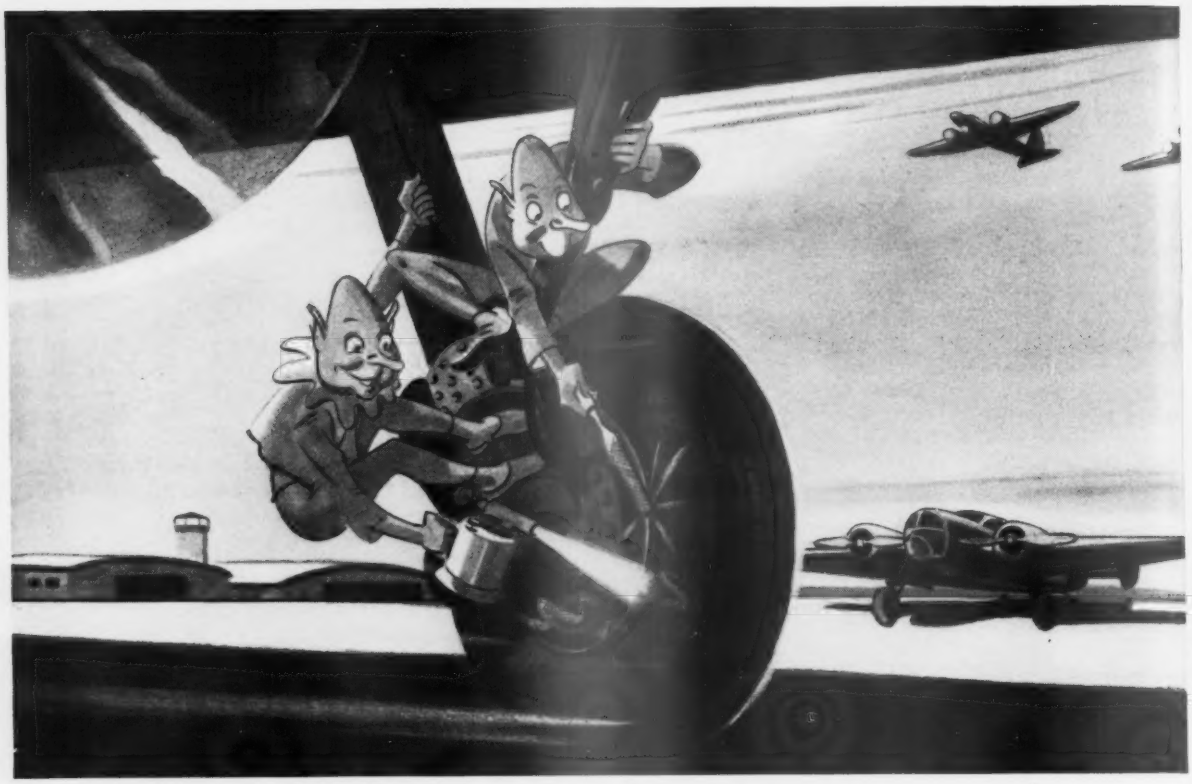
Las Alas Voladoras Actuales como Resultado del Estudio de los Futuros Aviones Gigantes (The Actual Flying Wing; a Result of the Study of Future Giant Airplanes). Juan B. De Nardo. A mathematical study is presented on the increase of size and weight of conventional airplanes. The writer expresses the opinion that such increases have their limits. He compares the characteristics of the Flying Wing with those of conventional airplanes and states his belief that a design of that kind has the greatest possibilities for development into the large transport plane of the future. *Avia*, August, 1942, pages 233–341, 18 illus.

Engines

Pendulum-Type Vibration Absorbers. R. G. Manley. A Letter to the Editor refers to the paper, "Optimum Performance of Pendulum-Type Torsional Vibration Absorbers," published in the *Journal of the Aeronautical Sciences*, July, 1942. The writer states that the volume of literature dealing with the theory of pendulum-type absorbers has grown steadily since the study of these devices was first put on a rational basis by Stieglitz. A notable description of the characteristics of absorbers has been given by Zdanowitch and Wilson, and the application to simple two- and three-mass systems (as well as to more complicated engine combinations) has been fully treated by Ker Wilson. Most authorities are now agreed that the simplest and most direct method of analysis is by use of the concept of "effective inertia," an introduction to which is given in the writer's "Fundamentals of Vibration Study." Any other method of attack is, of course, acceptable so long as the results are valid, but in the case of the paper under consideration an initial assumption nullifies the argument.

The solution by normal mathematical analysis is given, followed by a confirmatory solution by the effective-inertia method. By these means an expression is obtained for the (single) resonant frequency at any given order (ratio of forced frequency to rotational speed), and it is shown that the corresponding expression derived from Mr. Shieh's paper is inaccurate. The present contribution concludes with an inquiry into the source of error. *Journal of the Aeronautical Sciences*, January, 1943, pages 38, 39, 2 illus.

Centrifugally Cast Cylinder Barrels for Airplane Engines. Edwin F. Cone. Some information is presented on the centrifugal casting of cylinder barrels for aircraft engines which is being carried out at a Ford plant. It is explained that many details of alloy composition and processing are restricted. In opening, the writer points out that marked economies have been accomplished by substituting centrifugally cast products for forgings. How cylinders are being cast by the new process in a new $21,000,000 building is described. Details of the revolving molds in which the cylinders are cast are furnished, and the melting and pouring



Noisy-Landing Gremlins and young Widgets who overheat brakes, burn out brake materials and consider it great stuff to set up shrieking, grinding, chattering landings.

Gremlins and Widgets Beware!

Important work going on for more efficient aircraft brake materials

AMERICAN BRAKEBLOK aircraft brake materials are giving outstanding service on trainers, scout, observation and fighter planes, and on bombers.

As new plane and bomber types are developed, our laboratories and test rooms are constantly at work with the finest equipment available, creating new materials to meet new brake demands.

We would like to work with you whenever you believe we might help control the Gremlins and Widgets; and whenever you have new braking problems. Communicate with us at Detroit.

American Brakeblok
BRAKE LINING

THE AMERICAN BRAKE SHOE & FOUNDRY COMPANY

American Brakeblok Division, Detroit, Michigan

process is outlined. Other sections of the article cover heat-treating and machining, grinding and assembling, and properties and inspection. *Metals and Alloys*, December, 1942, pages 1062–1066, 10 illus.

Interchangeable Power Plants. A consideration of the advantages to be derived from the adoption of standardized power units and mountings. With the Rolls-Royce liquid-cooled Merlin engine and the Bristol air-cooled Hercules engine as examples, the article discusses the extent of the interchangeability and how it is achieved. One of the factors stressed is that, because of the design and layout, initial assembly in the aircraft and subsequent replacements of units under service conditions can be carried out without any structural modifications. It is stated that the time usually required for changing a standardized power plant is approximately 60 per cent less than formerly required. In addition to aiding production, standardization of engines is said to assist store routine and organization and to save much valuable time in obtaining delivery of parts and maintaining aircraft in operation. *Aircraft Production*, December, 1942, pages 705, 706, 4 illus.

Repair and Salvage of Aero-Engines. The writer describes an inspection of the South Wales factory of the Propeller and Engine Repair Auxiliary, a branch of the Overseas Airways Corporation, where the salvaging of parts from burned out and crashed airplane engines is being carried on. He first furnishes information on the arrangement and layout of the plant and then describes some of the salvage operations. Figures on the financial saving for a year obtained through these salvage operations are presented. *The Engineer*, December 11, 1942, pages 475–477, 6 illus.

German Radials. As released by the British Ministry of Aircraft Production, data are presented on three German aircraft engines: the B.M.W. 132K, 132N, and Bramo Fafnir 323P-1. The latter is a nine-cylinder, air-cooled, geared radial model with gasoline injection and a dual-speed, centrifugal-type supercharger. Particular attention is called to its epicyclic reduction gear and its fuel system. Four photographs of the engine are shown and figures are given on its bore, stroke, swept volume, compression and gear ratios, take-off power, and power on climb.

The B.M.W. 132 is an air-cooled, geared, nine-cylinder, radial engine with direct fuel injection, single-speed supercharger, and fixed-datum boost control employing double throttles. The principal difference between the two models lies in the propeller reduction and supercharger gears—the K type having a double planetary epicyclic propeller gear and the N type having single planetary gears. Features given special emphasis are: the temperature measurement, pressure delivery, oil venting arrangement, and injection pump operation. Illustrations of the engines are included, as well as a list of their specifications. *Flight*, December 3, 1942, pages 603–607, 10 illus.

Crankshafts for 300-hp. Lycoming radial airplane engines on a roller-conveyer line at The Aviation Corporation's Lycoming Division plant in Pennsylvania.

Aviation Casting. H. E. Linsley. The manufacture of castings for aviation engines is described, with particular attention to methods used by the Wright Aeronautical Corporation. Production operations are traced from the first step of making the pattern to the final sand-blast cleaning operation, after which the casting is ready for the machine shops. *Air Trails*, January, 1943, pages 10, 48, 50, 4 illus.

The Rolls-Royce "Merlin 61" Supercharged Fighter Engine. Following a visit to a plant of Rolls Royce, Ltd., made to inspect the firm's new Merlin 61 engine, which is being fitted to the improved Spitfire, the writer presents a description of this engine. It is brought out that by the use of a double-stage supercharger, with a water-cooled passage between the first and second stages of the supercharger and a cooler between the supercharger outlet and the induction pipe to the rear cylinder, it has been found possible with the new engine to develop double the power output at an altitude of 40,000 ft., as compared with that of the Merlin III, the first engine to be fitted to the Spitfire. A diagram shows the arrangement of the new supercharger. The writer discusses the progress in fighter engine design with particular reference to supercharging. Some specifications of the new Merlin model are furnished. *The Engineer*, December 18, 1942, pages 495–497, 3 illus.

Development of the Mighty Allison. Jerome Jacobs. An historic outline of the development of the Allison aircraft engine is presented. It is indicated that more than a decade of "sweat and toil" went into the designing of the first American 1,000-hp. liquid-cooled aircraft engine. Step-by-step improvements in the design of this engine are described. *Air-Age*, February, 1943, pages 16–18, 56, 57, 8 illus.

Flight Technique

Spins Aren't Dangerous. George H. Tweney. A study of the nature of spins, their cause, and preventives. It is stated that if sufficient flying speed is maintained at all altitudes an airplane will not stall or spin. The maneuver is defended as not being entirely destructive since it is useful in military flying. In specifying the dangers of spins, the first is listed as the suddenness with which the motion may begin without the pilot's desire; the second, the liability of its steady continuance for an indefinite time or until hitting the ground; the third, the rapidity and complexity of the rotation; the fourth, the fact that the use of the controls in coming out of the spin has to be just the opposite of

Courtesy, St. Louis Star-Times

They Ration Too—Without Complaint

THE BG CORPORATION — NEW YORK

what at first thought seems to be natural and instinctive; and the fifth, that a considerable amount of altitude has to be sacrificed in the process of recovery. *Aero Digest*, December, 1942, pages 164, 166, 271, 5 illus.

Flight Testing

Flight Research. J. Don Springer. Information is furnished on flight testing and research as carried out at the plant of the Bell Aircraft Company. *Air-Age*, February, 1943, pages 43, 57, 2 illus.

Fuels

"Oomph" in the Ether. Frances Caswell. An article telling how petroleum engineers are carrying on a production battle behind the lines to supply high-octane fuel to the Allied air forces. *Air-Age*, February, 1943, pages 34, 35, 61, 3 illus.

Gliding and Soaring

Glider Training in the A.T.C. As typified by the course given at the London Command School of Gliding, the glider instruction for British Air Training Corps cadets is outlined briefly. Initiated on June 28, 1942, the course is based on normal glider-training principles and is divided into a series of progressive stages. The article describes some of the equipment used. *The Aeroplane*, November 20, 1942, page 592, 5 illus.

High-Altitude Flying

Clothes Make the Airman. Donald O. Herty. After an interpretation of the enervating action that extreme cold has upon human efficiency, the writer discusses methods of overcoming the cold connected with high-altitude flying. He evaluates the solutions to the problem offered by extremely heavy clothing, electrically heated flying apparel, and heated cabins. Each has its limitations, and these are pointed out. The conclusion is that, while pressurized cabins can be used for commercial planes, for military flyers the best answer seems to be a combination of present-day fleece-lined flying suits with some form of artificial heating. *Flying*, January, 1943, pages 51, 108, 110, 112, 2 illus.

Instruments

Aircraft Instruments. The manufacturing and testing processes involved in the production of K.D.G. rate-of-climb indicators are described. Emphasizing the delicacy of the instrument and the need for accuracy in its manufacture, details are given on the machining and assembly of the three main units—the oyster or diaphragm, the mechanism, and the bakelite case and dial. Phases of the procedure which receive particular attention are: the pillar soldering jig, air leak adjustment, calibration vibration tests, and tapping equipment. Operation of the indicators and their design requirements are explained. *Aircraft Production*, December, 1942, pages 695–700, 17 illus.

Landing Gear

Retractable Landing Gear Aeronautical Problem Child. Problems of landing gear retraction are discussed and the development of the retractable landing gear is traced. It is shown that retractable landing gears must be engineered to surface travel considerations and at the same time shaped and modified by the demands of flight. Discussing the need for retractable landing gears, the writer draws attention to the fact that this was not keenly felt until aircraft speeds passed 190 m.p.h. How mechanical motivation of the landing gear gave way to hydraulic and electric lifting is described. *Air Tech*, November, 1942, pages 8–11, 24 illus.

Maintenance

It's Like the Old Shoe—It Fits. Paul E. Richter. T.W.A.'s vice-president states that the company's maintenance standards are higher than ever and explains the factors responsible for this condition. One is the efficiency of the maintenance dispatching procedure that schedules the planes in such a manner that large numbers of major changes and servicings do not fall due simultaneously; another is the skill and training of the maintenance crews; still another is their familiarity with the equipment. The quality of the equipment itself is also credited with contributing toward its longevity and service. Various figures are quoted to prove that, in spite of the increased use of T.W.A.'s transports because of their necessarily decreased number, maintenance and safety standards have not been sacrificed. *Aviation*, December, 1942, pages 102, 103, 315, 3 illus.

Air-line Engineering Management. Ivor Lusty. In this fourth installment of an article on the engineering management of air lines, consideration is given to reducing servicing cost by accurate scheduling of the maintenance work. A progress board is illustrated in which the progress of aircraft and their equipment through the inspection periods is indicated by pins that are moved progressively up the board. A chart also is presented showing the typical form of condition curves for a fleet on intensive summer operation and slight winter operation. *Aircraft Engineering*, November, 1942, pages 315, 316, 2 illus.

American and Continental Win Aviation's Maintenance Award. American Airlines and Continental Air Lines are announced as the winners of *Aviation's* Maintenance Awards—the former for air lines operating over 100,000,000 revenue passenger-miles per year, the latter for those operating less than that amount. In making the announcement, the growth of the air-lines' maintenance problems in the past year is reviewed. *Aviation*, December, 1942, page 112, 5 illus.

Royal Air Force Maintenance. "T." A brief outline is given of the work that is being done to keep Royal Air Force aircraft flying. The writer tells how the maintenance methods used in World War I have been revised. The subject is discussed under sections covering organization, daily inspections, minor inspections, major inspections, personnel, and equipment and spares. *Aeronautics*, December, 1942, page 49.

World Cargo Takes to the Air. Donald S. Sprague. A detailed study of the maintenance and design problems that have resulted from world-wide operation of transport aircraft. In addition to surveying the problems that have arisen from new combinations of weather and geography, the article also discusses means that have been developed to overcome them. The major portion of the article covers the design changes and maintenance practices necessitated by extremes of temperature, arctic and tropical conditions. In a "winterization" program, attention is directed to heating, ventilating, and deicing systems; aircraft insulation for the reduction of heat losses due to radiation; and proper lubrication for various airplane parts. For tropical operations, sand is dealt with as the chief maintenance difficulty.

Other effects of the expansion of our air-cargo systems upon maintenance procedures include problems connected with traveling from one temperature extreme to another, the increasing use of aromatic fuels, basic

DOW

The winged ingot is a symbol of freedom—graphic expression of Dow's recovery of magnesium, lightest of light metals, from sea water to release airplanes from hampering weight. When peace returns this symbol will reach full significance. Millions of pounds of Dow magnesium—also facilities for fabricating Dowmetal castings and wrought products—will speed transportation and lighten innumerable industrial and domestic tasks.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

PRODUCER OF THE LIGHTEST OF LIGHT METALS SINCE 1916

MAGNESIUM

INGOT • CASTINGS • FORGINGS • SHEET • STRIP • PLATE • EXTRUSIONS

limitations controlling cargo loading, items for the relief of crew fatigue, and condition of airports. Consideration is given to the extensive training required for maintenance personnel who must work in strange climates and foreign countries, the necessity for having spare parts and equipment, and the advantages of interchangeable and accessible parts. *Aviation*, December, 1942, pages 114–117, 331, 332, 335, 336, 339, 340, 343, 11 illus.

Fighter Fixin's. Tye M. Lett, Jr. A field engineer from the Allison Engine Division, who was with the Flying Tigers in the Far East, describes the maintenance problems with which the group was faced. Inadequate parts, lack of standardized equipment, and an absence of trained personnel were three of the main hindrances. The writer tells how these obstacles were overcome and suggests specific measures for conditions on other fighting fronts.

He sums up his conclusions by stressing the importance of the following: (1) centralized handling of supplies; (2) multiple communications; (3) emphasis on mobility of ground crew rather than the building of hangars and other buildings; (4) adequate earth-moving equipment on bases within the range of enemy bombers; (5) the necessity of establishing satellite fields and providing for their camouflage; (6) restudy of the unit system of ordering parts to increase efficiency of first and second maintenance echelons and to conserve labor and materials; (7) further promotion of standardization of aircraft not already of types used by American forces but those supplies to our allies. *Southern Flight*, December, 1942, pages 26, 43, 48, 50; "We Learned War Maintenance with the AVG," *Aviation*, December, 1942, pages 104–106, 316, 319, 320, 6 illus.

Fighting the Aircraft Maintenance War. Reagan C. Stunkel. The activities of private aircraft companies, as well as the Air Transport Command—helping to establish maintenance and overhaul bases, training personnel, delivering equipment all over the world, etc.—are described. An idea is given of the complexity and importance of aircraft maintenance in this war.... the scores of permanent and mobile bases that are required, the multiplicity of parts and equipment, the enormous numbers of trained personnel, the transportation facilities, and the need for accuracy and speed. *Aviation*, December, 1942, pages 118, 119, 344, 347, 6 illus.

Aircraft Maintenance in the Desert. Lt. Col. Robert Toland. The difficulties of maintaining aircraft in the North African area are given, and mention is made of the ways in which these obstacles are being overcome. Although sand is described as the main cause of trouble, other sources of hindrance and damage to airplanes are dealt with. These include: wind, extremes of temperature, insects, sudden storms, lack of water, and enormous distances. *Flying*, January, 1943, pages 29, 104, 106, 1 illus.

Adapting Assembly Line Techniques to Engine Overhaul. This brief article relates how the adoption of production line methods has facilitated engine overhaul at the Army Air Forces engine repair depot now functioning in Chicago & Southern Air Lines' shops at Memphis Municipal Airport. It also tells of a portable motor test stand, developed by this repair depot, which saves approximately one man-hour of work per engine. *Aviation*, December, 1942, pages 120, 121, 4 illus.

The Air Forces' Civilian Soldiers. Alfred Toombs. Thousands of civilians are employed by the Army Air Forces. With the majority of them working at the Air Forces' depots and subdepots, they are engaged mainly in overhaul, repair, and supply work. This article describes the maintenance and supply jobs that are open to civilians and lists the schools that offer training for them. It also relates the organization of the Air Forces' civilian group, the salaries that some of the jobs command, and the functions of the Air Service Command. *Flying*, January, 1943, pages 32–34, 116, 119, 3 illus.

Bringing Field Experience Back to the Plant. Frank H. Lyons. An outline of the functions, organization, and training methods of North American Aviation's field service department. It is the purpose and responsibility of this unit to coordinate operational and maintenance information between the home plant and the pilots and mechanics operating and servicing North American planes in the field. Three methods are employed to aid the maintenance of these aircraft in proper operating condition. One is an on-the-spot educational system conducted by one of the company's field service representatives who are assigned to posts throughout the world. The second is a factory training program for United States Army Air Forces personnel. The third is based on the preparation of flight, service, and repair manuals for the use of pilots and mechanics. *Aviation*, December, 1942, pages 124, 125, 323, 324, 327, 5 illus.

Womanpower in Airline Maintenance Shops. Charles N. James. The replacement of man power in the Western Air Lines' maintenance shop is demonstrated by the maintenance jobs that women are now taking over. The establishment of special facilities to permit fullest utilization of women for this work is noted. *Aviation*, December, 1942, pages 126, 127, 343, 344, 5 illus.

Synthetic Coatings Protect Engine Parts. Resistoflex PVA solution is used in the manufacturing of Rolls-Royce Merlin XX engines for resilient coverings on wire baskets to maintain undamaged surfaces in parts handling. Consisting mainly of a modified polyvinyl alcohol, the solution when processed is said to result in a coat that has the flexibility, elasticity, and resiliency of rubber but is not affected by gasoline, oils, and most organic solvents. *Aviation*, December, 1942, page 169, 3 illus.

Management

Control of Production. The outline of a production-control system that combines both planned output and record of progress. The article deals with all data directly affecting the build-up of charts and schedules. The following topics are detailed: process layout, manufacturing procedure, initial batches, manufacture of units, time of changeover, and standardization of working hours. Other subject headings include: the progress record, rectifications, applicability of modifications, and classification of labor. *Aircraft Production*, December, 1942, pages 724–726, 1 illus.

Materials

Low Temperature Synthetics. Paul A. Anderson. Characteristics of synthetic rubber are outlined, particularly the conditions when the material is subjected to low temperatures. Progress in design and compounding the product is reviewed, and the belief is expressed that these compounds will be satisfactory for use on all but a few of the world's aviation fields. Consideration is given to the requirements imposed upon synthetic rubber parts when subjected to temperatures as low as —40°F., and it is indicated that it is necessary to make provision for temperatures down to —70°F., since these requirements are being approached in large measure. Reasons for selecting certain kinds of stocks are set forth and comparisons are made with natural rubber. The characteristics of certain synthetics and the procedure for low-temperature test control are described. *Aero Digest*, December, 1942, pages 184, 279, 2 illus.

Plating on Aluminum. Raymond F. Yates. The writer discusses problems connected with the plating of other metals on aluminum, one of which is the achieving of satisfactory adhesion. He describes in particular the Travers' Krome-Alume method. It is pointed out that, while all previous attempts to electroplate metals on aluminum sought to eliminate all traces of oxide, in the Travers' Krome-Alume method, anodic oxidation after cleaning is the first step. It is further noted that the more perfect the anodic coat the greater is the adhesion established. Information is presented on the operations involved. It is stated that the crux of the process lies in the modification of the anodic film before plating. The plating of duralumin alloys and the cadmium plating of aluminum are described. Consideration is given to functional applications and the problem of cost. *Metals and Alloys*, December, 1942, pages 1084–1088, 5 illus.

Metal Degreasing. Information is offered on the cleaning of metal surfaces in preparation for painting and plating. Degreasing systems, commercial degreasing machines, and degreasing solvents are discussed. It is stated that frequently a most efficient setup can be made in the shops of those doing the metal cleaning, since such a machine will be best adapted to the user's particular needs. Eight points that should be borne in mind when choosing a degreasing agent are listed. These are solvent action, fire hazard, toxicity, boiling point, solubility and ease of separation from water, latent heat of vaporization and specific heat, specific gravity, and corrosion. These points are discussed in considerable detail. *Aircraft Engineering*, November, 1942, pages 329–330.

Clasificatión de las Maderas Nacionales y su Posible Utilización en la Industria Aeronautica (Classification of Domestic Timber and Its Possible Utilization in the Aeronautical Industry). Juan I. San Martin and Mario M. Rumbo. This study presents a classification of 38 species of Argentine forest trees. This classification was made to determine their various properties as to specific weight, durability, toughness, and strength and to make possible the proper selection for their use in aeronautical construction. According to this investigation, Argentina has a sufficient variety of wood which could be used in airplane construction. However, it is indicated that the lumber mills must apply more rational and scientific methods in order to supply the best and most seasoned qualities, fit to withstand climatic and organic changes. *Avia*, July, 1942, pages 199–207, 2 illus.

Says Structural Materials Won't Limit Cargo Plane Size. Information from a paper on structural materials for aircraft, read by H. D. Hockstra of the Civil Aeronautics Administration, before the Society of Automotive Engineers, is presented. It is stated that airplanes can be constructed from any of the presently known and commonly employed structural materials. The continued extensive use of aluminum alloys and stainless steels is predicted, with magnesium alloys and wood continuing to hold important places. Structural materials do not appear to be a limiting factor in the size of airplanes. Research now under way may well uncover new types of materials of great merit. *American Aviation*, December 15, 1942, page 27, 1 illus.

Medicine

Ironing Out the Washouters. Devon Francis. The avowed purpose of this article is to show that it is possible for a man with obvious physical defects to be a better pilot than one who is approved by the American Medical Association as a perfect

Memo on Motors...
(FOR YOUR "NEW PRODUCTS" FILE)
★

★ When you are confronted with a motor problem, whether for new or redesigned equipment, we suggest that you keep the following points in mind:

First, the experience of a motor manufacturer who specializes in fractional horsepower, special application motors can be extremely valuable to your engineering department.

Second, because it usually requires considerable time to thoroughly analyze the various problems of motor design and application, it is advisable to discuss the motor in the early stages of product development.

Third, satisfactory performance depends vitally upon *thorough engineering*—featured in all Black & Decker motors.

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO

THOROUGH ENGINEERING is the basic factor behind the successful operation of this hydraulic pump motor and many other fractional horsepower motors we have designed for all types of equipment

BLACK & DECKER

★ SPECIAL APPLICATION **MOTORS** FRACTIONAL HORSEPOWER

physical specimen. The writer claims that good judgment and quick thinking are more important than physical perfection and that the government's physical tests for civilian airmen are badly in need of reformation. Advancing arguments against the theories that perfect sight and depth perception are necessary, he advocates the adoption by the C.A.A. of more objective and uniform standards of physical examination. *Skyways*, January, 1943, pages 12, 13, 62, 66, 7 illus.

Metallurgy

The Metallurgy of Modern Alloys. R. H. Harrington. The second installment of a discussion of heat-treating definitions is presented. It covers precipitation hardening alloys. *Heat treating and Forging*, December, 1942, pages 627–630, 1 illus.

The Influence of Delayed Quenching During Solution Heat-Treatment on the Resistance of Duralumin to Intercrystalline Corrosion. J. C. Arrowsmith and G. Murray. This article covers an investigation of the influence of delayed quenching during solution heat-treatment on the resistance of duralumin to intercrystalline corrosion. It was found that the delay should not be more than 10 sec. if a high degree of resistance to intercrystalline corrosion is to be insured in thin gauge metal. Coastal atmospheric corrosion tests on duralumin-type alloys that were protected by various types of surface treatment also are described. They showed that acceleration corrosion tests on the bare metal should not be regarded as a sure indication of the ability of a material to withstand service conditions. *Sheet Metal Industries*, December, 1942, pages 1879–1884, 1910, 9 illus.

Substitutes for Leaded Bearing Bronze. R. W. Dayton, H. W. Gillett and L. E. Balch. In this article the writers review several possible substitutes for leaded bearing bronze. They present test data on the actual mechanical properties and relative bearing qualities of alternates that appear most likely to be of value. *Metals and Alloys*, December, 1942, pages 1072–1079.

The Fatigue Strength of Heavily Chromium-Plated Dural. A Beerwald. This article, which was taken from *Luftfahrtforschung*, covers an examination of the influence of hard chromium plating (that is, plating with a thick coating of chromium) on the fatigue strength of light metal alloys, especially duraluminum. The writer investigates possible causes of loss of strength. *Sheet Metal Industries*, December, 1942, pages 1889–1891, 1 illus.

Meteorology

Combined Effects of Ascent and Divergence on the Lapse Rate. Horace R. Byers. A discussion is presented of the conditions under which adiabatic ascent or subsidence involving whole atmospheric layers occurs and the vertical temperature lapse rate in these layers changes. It is stated that similar effects on the lapse rate result from mass removal or accumulation (lateral divergence or convergence). These occurrences make the lapse rate depart more and more from the adiabatic equilibrium rate. When ascent and divergence are occurring together, two opposing effects on the lapse rate would be noted, and this would also be the case when subsidence and convergence are occurring together. A mathematical treatment is developed for the purpose of determining the amount of divergence or convergence required to preserve the lapse rate against change caused by lifting or subsidence. Only the dry adiabatic case is considered. *Bulletin of the American Meteorological Society*, October, 1942, pages 319, 320.

Weather . . . Offensive Weapon. Capt. William H. Graham, Jr. The importance of accurate weather forecasting in the prosecution of military campaigns is emphasized in this article. Reference is made to the advance in aerology since World War I, which was brought about in part by the demands for safer flying of a rapidly growing peacetime aviation fraternity. Since the beginning of World War II great advances in aerology have occurred. The tactical use of weather in military flying is discussed. How weather conditions have affected certain enemy military campaigns is described. Some information is furnished on the activities of the Army Air Forces Directorate, which furnishes weather service in all theaters in which the Allies are operating. *National Aeronautics*, December, 1942, pages 16, 17, 7 illus.

The Anatomy of Air. In this article the writer presents a description of the air's composition, atmosphere levels, and cloud composition. *Air Tech*, November, 1942, pages 14, 15, 47, 4 illus.

El Plan Integral de los Servicios Meteorologicos (The Integral Plan of the Meteorological Services). Carmelo Di Corleto. The first of a series of articles reviews the history of the meteorologic service in Argentina from its beginning in 1930. At that time two aerologic stations were established (Villa Ortuzar and Santiago del Estero), but the writer indicates that their value in regard to aeronautics was not great. However, through the efforts of interested parties, success was attained in centralizing the meteorologic service so that it could be effective. From the two original stations there has grown a network that consists today of 22 stations, all equipped with sounding balloons. The writer outlines the services required of a meteorologic station, with special reference to its connection with aeronautics.

In the second of this series of articles attention is called to the United States Weather Bureau and its importance to air navigation. A similar service is proposed for Argentina with the cooperation of the Post Office and Telegraph Department. It is suggested that the entire country be divided into sections according to their climatic conditions and the particular characteristics of the course of the weather in each of these sections. Special consideration is given to the ground organizations and the meteorologic instruments employed by them. These instruments are described. *Mundo Aeronautico*, September, 1942, pages 2–5, 1 illus.; October, 1942, pages 26, 27.

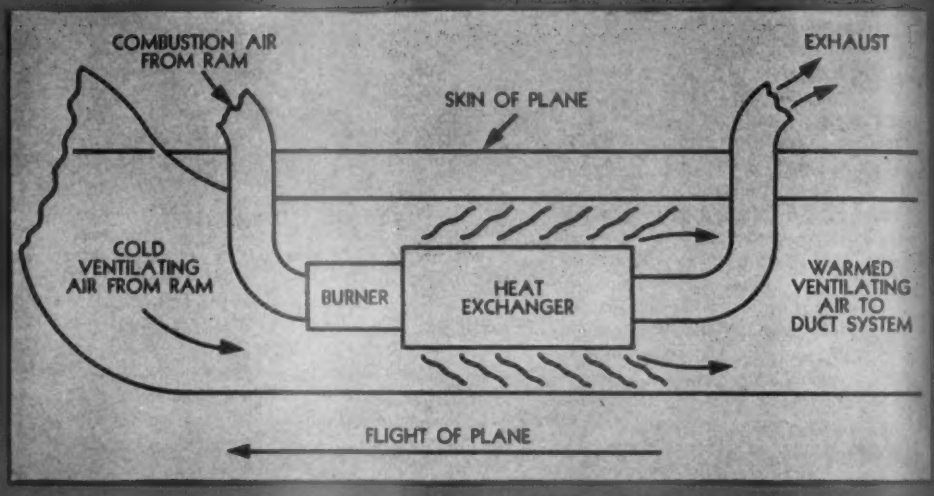
Military Aviation

Commandos with Wings. Seton David, Jr. The writer emphasizes the military value of glider-borne troops, which, it is stated, was foreseen years ago by Germany. Glider development in various countries is described, and what has been accomplished with gliders in military actions is outlined. How the American aircraft industry responded to the call for more gliders is set forth. Glider testing and the glider training program are discussed. *Air-Age*, February, 1943, pages 6–9, 64–66, 6 illus.

From Sylt to Cologne. The writer reveals changes in the methods of bombing land targets by tracing air-raid operations of the R.A.F. from the time of the first big attack on the seaplane base at Sylt in March, 1940, to the recent raids on Cologne. Policies and tactics of land target bombing are discussed. *The Royal Air Force Quarterly*, December, 1942, pages 16–20, 4 illus.

Finding Night Targets. Lt. Col. A. Goryev. An officer of the Soviet air force describes several methods employed by Russian night bombers to find their targets. One is the use of illuminator aircraft, assigned to drop flares over the target for bombers

ANNOUNCING—A SE
COMBUSTION-TYPE AI



Schematic diagram of new, simplified combustion-type South Wind heating method.

Ram-Air Operation—No Pumps or Blowers —Lower Weight Installed

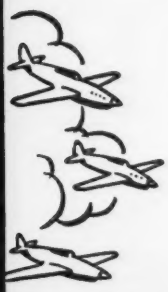
EMBODYING the results of three years of intensive developments, the South Wind ram-air-operated heater has now been developed in four new models.

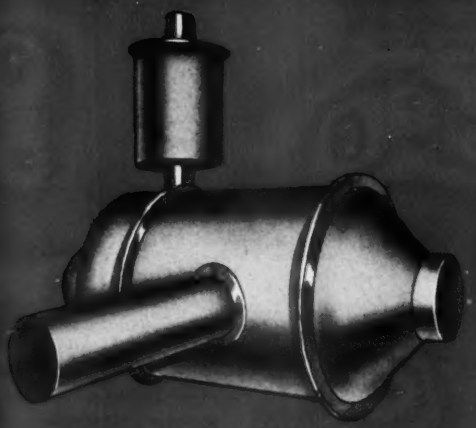
First demonstrated to the airplane industry in 1940, this new type South Wind heater eliminates the need for the pumps and blowers which often caused problems of space or weight. Nor are these heaters dependent on engine connection. Only a fuel supply and brief supply of electricity for starting are required.

Both ventilating and combustion air supply are provided by air rams. A new pressure-balance principle—developed and proved under laboratory and flight conditions—adds to dependability and assures complete safety. . . . Once more Stewart-Warner's long cooperation with aviation engineers—our world-wide field experience —and our unmatched engineering facilities in this specialized heating field—provide pre-tested and proved equipment to meet the industry's needs.

ARMY E NAVY

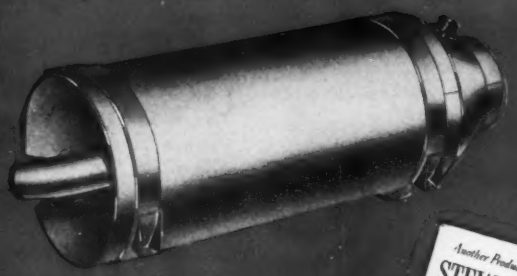
—A SERIES OF NEW
YPE AIRCRAFT HEATERS





New Ram-Air Operated South Winds Offered In Wide Range of Heat Output Capacities.

Photographs, weight and space-displacement specifications, as well as heat output data on the four heaters illustrated here are available to persons authorized to receive such restricted or classified information. An unusual latitude of adaptability to heating requirements is provided by these new type heaters.



Another Product of STEWART WARNER

South Wind HERMETIC COMBUSTION HEATERS

REG. U. S. PAT. OFF.

HEATER DIVISION, STEWART-WARNER CORP., CHICAGO

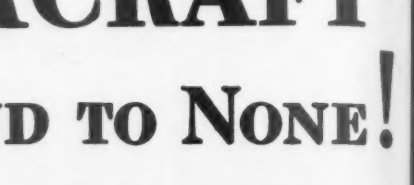
West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service, 1273 Westwood Blvd., West Los Angeles, California

These Martin Firsts help make

U. S. AIRCRAFT

SECOND TO NONE!

FIRST all-plastic aircraft nose, used on the Martin B-26, giving bombardier full visibility and absorbing recoil of forward gun. Martin was working on plastic noses and other parts as far back as 1921. Today some Martin types contain 400 plastic parts.



FIRST to develop photo-layout method, utilizing giant camera. Through this method, scale photos are reproduced directly on sheet metal, thus speeding production. Moreover, drawings may be scaled up or down swiftly, accurately.

FIRST to develop "heat therapy" for airplane wings. A giant heating "pad" is applied to aluminum covering of wing, expanding this "skin." Riveted when hot, skin shrinks when cool, fits tightly over spars without wrinkling or buckling.

FIRST U. S. power-operated gun turrets, giving our bombers strong protection against enemy interceptors. Martin manufactures these turrets not only for Martin bombers but also for many other types of American aircraft.

FIRST U. S. self-sealing fuel tank. Martin Mareng tanks are now standard equipment on many American aircraft. Martin experiments on self-sealing fuel tanks date from 1919, during which period over 285 different materials were tested.

These are only a few Martin "firsts." Some are still close-guarded military developments, while numerous others, individually minor but collectively important, are in use throughout the aviation industry. But Martin engineers are never satisfied. In scores of diverse fields, work goes on to give America even mightier planes for today's aerial fights, tomorrow's peacetime flights.

Martin

AIRCRAFT

Builders of Dependable Aircraft Since 1909

that follow them. Relieving the bomber from dropping its own flares eliminates the necessity for a return to the spot where it has dropped the flare. Another method is having the bombers travel tandem fashion, each bomber dropping a flare for the one succeeding it. Navigation factors and their part in deceiving the enemy with regard to the raiding aircraft and means of blinding anti-aircraft searchlight crews are also discussed. *Flight*, November 12, 1942, pages 530, 531.

Organization of the Army Air Forces. Major Nathaniel F. Silsbee. The accomplishments of the air forces of the United Nations during 1942 are reviewed briefly, to which is added an analysis of the activities of the U.S. Army Air Forces. Mention is made of the different commands that constitute the air branch of the Army, together with an explanation of how the Army Air Forces operates. The American record is reviewed, with particular reference to the outstanding individual airplanes. The ways in which American production methods are being adapted to the rapid changes required in military aviation are noted. It is shown that American warplanes have performed satisfactorily, and confidence is expressed that this nation will be able to maintain its leading position in the race for military air supremacy. A chart shows the organization of the Army Air Forces. *S.A.E. Journal*, January, 1943, pages 42–45.

Atta Girls! Joan Bradbrooke. The purpose, work, organization, personnel, and training of the British Air Transport Auxiliary are described. A step-by-step account of a typical job in ferrying a plane from factory to R.A.F. squadron is included. Mention is also made of the fact that American women pilots are members of this important British organization. *Skyways*, January, 1943, pages 34, 35, 44, 45, 73, 8 illus.

Air Force Ranks Related. The methods used by different countries in ranking the officers and men of their air forces are described. A table shows the systems used by the British, Americans, French, Poles, Czechoslovakians, Chinese, Russians, Germans, Japanese, and Italians. It is pointed out that while in most Allied and enemy forces the ranks of the officers and men are the same as those used by their armies, the Royal Air Force creates its own names. *Aeronautics*, December, 1942, pages 54, 55.

Dive-Bombing Is Not New! Martin Powell. The writer tells how dive-bombing technique was displayed by the United States Marines as far back as 1926 when a Marine air unit went to the rescue of a garrison in Nicaragua. *Air-Age*, February, 1943, page 15, 1 illus.

U.S. Rubber Company's seven-man inflatable raft for Flying Fortresses is now in production. Among the many comfort features is this tarpaulin to protect men against sun and rain. Boat is 12 ft. long; 5 ft., 8 in. wide; and folds into a case 3 by $1^1/_2$ ft. As the boat inflates, the carrying case becomes a sea anchor to keep the boat from floating away. The sea anchor can then be used to keep the nose of the boat into the wind and to reduce the possibility of tipping from heavy seas. (*See* "From the Industry.")

Army Air Forces Materiel Command Administers Gigantic Aircraft Program. Leslie Peat. In this article an outline is presented of the organization and personnel of the Army Air Forces Matériel Center at Wright Field, Dayton. *S.A.E. Journal*, January, 1943, pages 22–24, 53, 16 illus.

Spitfires Above 40,000 Ft. An account of how three German long-range reconnaissance planes, designed to fly in the stratosphere, were brought down by British pilots in Spitfires. While the German airplanes were equipped with pressure cabins, it is commented that so far as was known the British pilots did not even have pressure suits to assist them in fighting and flying at a height of nearly 50,000 ft. *Flight*, December 3, 1942, page 612.

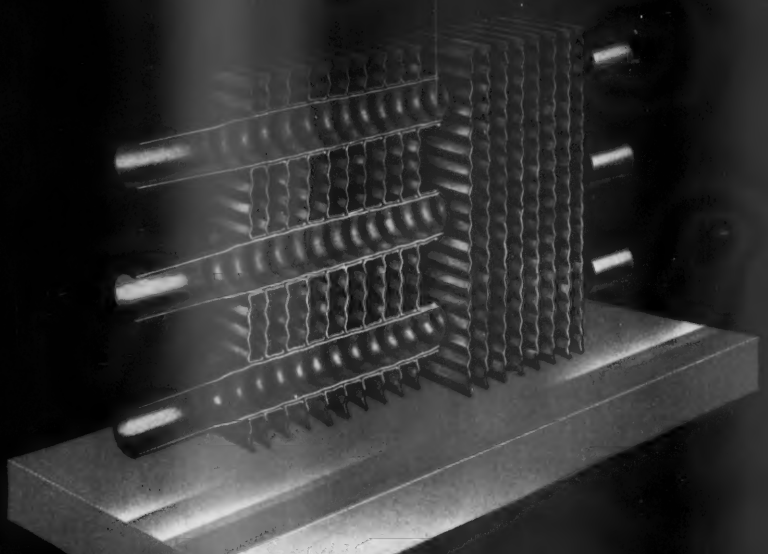
A Camel Outblows a Hurricane! David C. Cooke. Although unsupported, a report is made on a sham air battle between a World War I Sopwith Camel and one of the R.A.F.'s new Hawker Hurricane fighters which is supposed to have taken place for experimental purposes at the order of an R.A.F. colonel. It is claimed that photographs taken by camera guns during the battle showed the Camel to have scored a decisive victory. An account of this incident is related to substantiate the contention that speed is not all-important in an airplane dogfight. *Skyways*, January, 1943, pages 38, 39, 2 illus.

Air Attack by Numbers. John Harmer. Nine points considered important if the bomber is to attain its maximum efficiency as a weapon are outlined. It is explained that the first point that must be considered is in what capacity the bomber is to be used. It can be employed as artillery, as a seige weapon, or as an implement of sabotage. The three methods of employment are discussed. Consideration then is given to the types of targets to be bombed and the time factor. Other points discussed are aircraft loss against production, manpower loss against training, risk against priority, economy of force, damage against loss, bomb types, and bombing policy. *Aeronautics*, December, 1942, pages 73, 74, 77, 78, 5 illus.

Apuntes de Tactica Aerea (Notes on Aerial Tactics). Felix Olmedo. The writer, who was attached to the U.S. Army Air Forces, presents in this first article of a series some brief notes on the experiences he gathered while with this service. As aerial combat differs so much from land or sea warfare, special consideration has to be given to proper aiming, the number and quality of firearms used, and the ammunition needed, correct estimation of distances, and concentration of fire power. In addition to the type of arms, whether fixed or flexible, vibrations and flight characteristics of the airplane are considered. Mention is made of the factors that affect the tactics of aerial combat. These include the effect of morale and good leadership, the effect of surprise, and the limitations of the fighter planes. Some fighting tactics employed by the Germans are described. Other subjects covered are combat tactics used by the crews of airplanes that are equipped with flexible machine guns or with turrets and attacks by airplanes with fixed machine guns. *Revista de la Fuerza Aerea*, July, August, September, 1942, pages 12–20.

Model Airplanes

Now, Plastic Models. Robert L. Brown. An article giving information on how airplane models can be built of plastics. "Weldwood," a plastic glue manufactured by the United States Plywood Corporation, is used in this process. It is explained that models built by the new method are as light or lighter than those made of balsa. They also have a compression, tensile, and impact strength many times greater than balsa, it is stated. The writer describes how to carve the hardwood forms on which



Now McQUAY GIVES YOU RIPPLE FIN COILS

THEY'RE SHOCK PROOF

More STRENGTH More DURABLE More EFFICIENT More HEAT TRANSFER

The Navy said "shock proof," so McQuay engineers produced RIPPLE FIN Coils. These new McQuay Coils, available for both heating and cooling, provide a more efficient surface of superior strength and durability. The RIPPLED fins have additional surface that transmits more heat. The RIPPLES also provide ample stiffness—preventing bending of the fins under the most severe conditions. Thousands of McQuay Coils have been and are being furnished for the navy's fighting ships. McQuay, Inc., 1632 Broadway N. E., Minneapolis, Minn.

McQuay INC. . . . . AIR TEMPERING EQUIPMENT ESPECIALLY DESIGNED FOR INDUSTRY

AIRCRAFT HEATING ASSEMBLY

CONVECTOR RADIATOR

CANTONMENT HEATING UNIT

VENTILATION HEATERS NAVY TYPE

AIRCRAFT HEATING SECT

are applied layers of laminating material impregnated with the plastic glue. *Air Trails*, February, 1943, pages 29–31, 8 illus.

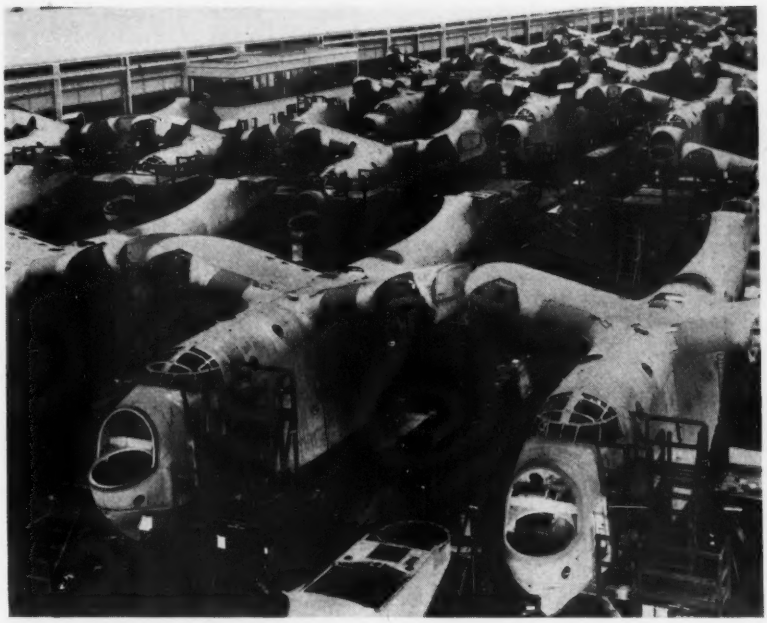
Naval Aviation

Our Navy Strikes from the Sky. William S. Friedman. Information is furnished on the combat planes that support war vessels of the United States Navy. The writer states that it is becoming increasingly apparent that naval vessels, once the backbone of naval strategy, have been transformed by shifting events into bases and auxiliaries for aircraft. Reasons for this change are presented. It is pointed out that planes from a carrier can cause destruction farther and faster than the best ships of the line. The writer emphasizes the effectiveness of the dive bomber as an instrument of warfare and states that for pure deadliness, accuracy, and economy of fire it can outstrip the big naval guns. Reference also is made to the torpedo-carrying airplane. The performance of the various types of naval aircraft in active service is described. *Popular Science*, February, 1943, pages 68–76, 233, 235, 25 illus.

Flat Top Finesse. A discussion of the aircraft carrier's role in modern warfare. After tracing the development of aircraft carriers, the article points out the dual aspect of their usefulness....first as fighting ships and second as floating airports. It relates what personnel are necessary to man the carriers and indicates the specialized training of both flying and nonflying members. *Southern Flight*, December, 1942, pages 44–47, 7 illus.

Flying Without Wings of Gold. Hal Goodwin and Peter Harkins. In praise of the Navy's enlisted pilots, a series of exploits is recounted. These portray feats of heroism and ability performed by individual "white hat flyers" or aviation machinist's mates. In addition to listing citations that have been won by this class of pilots, the article also reviews the steps many of them have taken in their promotions from enlisted men to commissioned officers. *Skyways*, January, 1943, pages 14, 15, 68, 79, 7 illus.

Catafighters. Keith Ayling. The article contains a description of how the British are using landplane fighters catapulted from freighters as a means of combating Focke-Wulf bombers and Heinkel torpedo planes attacking ships. It is explained that early in the war German long-range bombers that could attack vessels well out of range of land-based fighter protection were becoming a growing menace to transatlantic shipping. The outlined method of catapulting



One of the first released photographs of Navy Mariner patrol bombers on the assembly line at The Glenn L. Martin Company plant.

Spitfire planes from freight vessels was developed to meet the situation. *Air Trails*, January, 1943, pages 12 13, 44, 3 illus.

Coastal Patrol. An article describing the part United States Navy blimps are playing in actions against enemy U-boats. *National Aeronautics*, December, 1942, pages 19, 34, 6 illus.

Reseña Historica Del Avion Torpedero (Historical Review of the Torpedo Plane). Horacio Barrientos. A chronologic survey is presented of the development of the torpedo plane from 1911 to the present. A table shows the types of torpedo planes in actual use by the warring nations and gives flying speed and flying range of these planes and also whether they are single-engined or multiengined. The number of torpedos carried is noted. *Revista de la Fuerza Aerea*, July, August, September, 1942, pages 21–25.

Torpedo Bombers Again. L. W. Rosenthal. The writer shows why specifications for torpedo bombers, drafted in recent articles and letters published in *Flight*, cannot be met. He criticizes these on the grounds that the torpedo-carrying aircraft they advocate cannot conform to Fleet Air Arm restrictions with regard to range and total weight. His arguments are supported by analytical figures on the considerations involved. *Flight*, November 19, 1942, pages 561, 562.

Parachutes

Life Rafts of the Air. This article deals with the design and operation of parachutes. Ten basic requirements of a good lifesaving parachute are enumerated. It is emphasized that, in addition to good design, the efficiency of a parachute depends on high standards of material and manufacture. Other sections of the article cover substitutes for silk, packing the parachute, storage, and jumping technique. *Air Tech*, November, 1942, pages 18–20, 52, 6 illus.

Something About Parachutes. G. G. Grey. General comments on parachutes are contained in the first of a two-part article. The writer tells about the Caterpillar Club and speculates upon the numbers of people whose lives have been saved by parachutes. He divides these into three classes: those who jumped from planes before the war, those who were compelled to jump by enemy action, and those who jumped in Britain either in training or on Service flights. The history of parachutes until about the end of the last war is reviewed briefly.

The second part of the discussion on parachutes criticizes the British Air Ministry ban on parachutes during the last war, notes several parachute manufacturers and their contribution to parachute development, and comments upon the responsibility of parachute packers in the R.A.F. Among the parachute companies, the two accorded greatest prominence are the Irving Airchute Company and the Parachute Company. *The Aeroplane*, November 20, 1942, pages 594, 595, 4 illus.; November 27, 1942, pages 620, 621, 1 illus.

Garment Parachute. Rowland Carter. Information is given on a combination flying suit and parachute recently patented. The design provides for a strongly reinforced flight jacket with the major portion of the harness straps built into it. Stating that the invention requires certain refinements before complete acceptance by the air services, it is indicated that one of these is the reduction of the jacket weight so that it will be less than the combined weight of a separate jacket and parachute. *Flying*, January, 1943, page 56, 1 illus.

Personalities

The Sky's the Limit. Corey Ford and Alastair MacBain. A "human interest" portrait of Lt. Gen. Henry Harley Arnold. From 1912, when he was one of the first four military pilots in this country, to his present position as Commanding General of the U.S. Army Air Forces, the affect of "Hap's" forceful personality upon the events in his life is stressed. His ability to maintain contact with all types of people and his indefatigability are characteristics particularly lauded. *Collier's*, January 9, 1943, pages 18–20, 63, 4 illus.

Leaders of the Luftwaffe—XIII. H. J. A. W. Kurt Student, Officer Commanding the Eleventh Air Corps, is one Luftwaffe general who is highly praised by the writer of this series of articles. Tracing his career from the pioneer flying days of 1913, he is commended as an intelligent, energetic, courageous, and honest leader. He is best known for his exploitation of parachute troops and air-borne infantry and their successful use in Holland and Crete. Unconcerned with politics, to Student the job comes first and his own interests last. *The Aeroplane*, December 4, 1942, page 647, 1 illus.

Eddie Rickenbacker, the Happy Hero, Returns. Thomas F. Collison. A character study of Eddie Rickenbacker, with biographic details on his life. He is followed through his career as an automobile racing driver, a first World War aviator, a national hero, a business man, and finally President of Eastern Air Lines. The article concludes with the proposal that Rickenbacker be made America's next Secretary of War. *Skyways*, January, 1943, pages 10, 11, 56, 57, 64, 6 illus.

Leaders of the Luftwaffe—IX. H. J. A. W. Bruno Lorzer, Commander-in-Chief of the Luftwaffe's Second Air Corps is characterized in this installment. Lorzer is commended as an excellent pilot with a practical knowledge of the job he has to do. Although not a good strategist or a clever tactician, his judgment is acknowledged to be good and his experience extensive. In spite of his good qualities, however, his long friendship with Göring is deemed largely responsible for his present position. *The Aeroplane*, November 6, 1942, page 541, 1 illus.

Father of the Fighter. Keith Ayling. The life history of Capt. Frank Barnwell, British Aircraft builder, who was killed in 1938 when testing a normal-sized airplane equipped with a motorcycle engine, is presented. He created the Bristol two-seater fighter, which, it is stated, was the most successful aircraft of World War I. Other planes he built are described, the last contribution being the Blenheim. *Air Trails*, February, 1943, pages 14, 15, 67–69, 4 illus.

Leaders of the Luftwaffe—XI. H. J. A. W. In this installment the career of Robert Ritter von Greim, Commander of the Luftwaffe's Fifth Air Corps, is depicted. A veteran pilot of the first World War, he is called one of the best German Air Force generals. Portrayed as a professional airman, it is said that his loyalty to the Nazi party is based not only on his friendship for Hitler but also on the fact that the Nazis have enabled him to take a leading part in the world of military aeronautics. The writer considers him one of the experienced men in the Luftwaffe, who takes orders from above and gives them the fullest interpretation that sound knowledge can afford. A chronologic tabulation of the highlights in his life is given. *The Aeroplane*, November 20, 1942, page 591, 1 illus.

Leaders of the Luftwaffe—XII. H. J. A. W. The twelfth of this series of articles is devoted to a brief biography of Helmut Forster, Commander of the Luftwaffe's First Air Corps, Leningrad Front. A veteran pilot since 1910, the writer judges his experience to be of great value. Although his leadership is not deemed brilliant, it is called sound. Forster is said to support the Nazi party mainly because it accorded him recognition and because it revived the power of the German armed forces. *The Aeroplane*, November 27, 1942, page 619, 1 illus.

Personnel

Don't Draft Our Student Engineers! Denoting the vital importance of maintaining an adequate supply of skilled engineering personnel in the aircraft industry, this article urges Selective Service deferment for aero-

The number of men in a plane or tank crew is kept to a minimum. Each man has his job to do. This *minimum of manpower* requires a *maximum of motor power* . . . motor-controlled apparatus that operates at the touch of a finger and functions with utmost accuracy. *Eicor D. C. Motors* have been developed to a high degree of efficiency. They are remarkably light in weight for power output—thoroughly reliable—and are used to actuate instruments, turrets, fire control and other critical equipment. This advanced engineering is your assurance of better motors at lower cost *tomorrow!*

EICOR INC. 1501 W. Congress St., Chicago, U.S.A.
DYNAMOTORS • D. C. MOTORS • POWER PLANTS • CONVERTERS
Export: Ad Auriemo, 89 Broad St., New York, U. S. A. Cable: Auriemo, New York

nautical engineering students. The problem of design flexibility to meet new service requirements is discussed, with consideration of how the proposed deferment affects it. A policy regarding the draft eligibility of aeronautical engineering students is proposed along the following lines: (1) Programs of instruction in aeronautical engineering would be telescoped in time and pruned of non-essential subjects. (2) Most juniors and seniors in aeronautical engineering schools would be allowed to complete their courses subject to rigorous standards of scholarship and ability. Should they fall below the set standards, they would automatically lose their deferment, even though the number of juniors and seniors in aeronautics is severely limited and must be considered one of the nation's vital resources—to be guarded and regulated like rubber. (3) Alternatively, juniors and seniors might hold reserve commissions in the A.A.F. or in Naval aviation but not in such number as to leave an insufficient choice of men for industry. (4) High-school graduates would be admitted in liberal numbers but only after the most rigorous selection. Nevertheless, the number of entering students should actually be increased. (5) Freshmen and sophomores would be allowed to continue their studies only if they showed exceptional promise. Their selection would be in the hands of special boards, composed of Army, Navy, university, and well-qualified public members. But their numbers might well be increased in view of the urgent demand and because no one can foretell how long the war will last. (6) Students might conceivably be drafted and furloughed for educational and, subsequently, industrial work. *Aero Digest*, December, 1942, pages 171, 172, 177, 280, 283, 5 illus.

Photography

"On the Record." Ted Erickson. An article relating how the photographic laboratory at the Jacksonville Naval Air Station is making a complete picture record of the way men prepare for war. Information is furnished on the work of aerial photographers who make picture maps of coastal bases and use infrared films and a modern version of the stereoscope to detect and perfect camouflage. It is explained that on the ground photographs are made to show the progress in construction work and to illustrate other activities. The way photographs are being used to prevent the waste of materials is also outlined. *Dixie Air News*, December, 1942, page 10, 1 illus.

Plastics and Plywood

Plywood in Aircraft Construction. G. A. Allward. Reference is made to the fact that aircraft production demands have forced manufacturers to explore the field of aluminum substitute materials. Attention is drawn to the advantages of plywood as compared with plastics for aircraft structural members. Compared to the wealth of engineering information on metal structures, information on plywood is meager. Steps being taken to remedy the situation are mentioned. The properties and manufacture of wood veneers are discussed. Other sections of the article deal with the selection of veneer, glues and gluing, the utility of plywood as a structural material, and the weathering properties of plywood. *Mechanical Engineering*, January, 1943, pages 14–16, 1 illus.

Elastic Plastics for War Production. J. R. Price. An article presenting the advantages of vinyl chloride-acetate resins as a substitute for rubber in war production. The properties of these elastic plastics are described and listed. Applications are enumerated and illustrated. *Modern Plastics*, December, 1942, pages 48–52, 12 illus.

Design Considerations for Plywood Structures...II. L. J. Marhoefer. In the second of a series of articles on plywood airplane design, the writer discusses limitations imposed by fabrication processes and explores new features of basic design which have been made possible through the use of plywood. Fluid-pressure molding methods are outlined, with details for the handling of moldable pieces and integral reinforcing. A detailed discussion is presented of the bonding of reinforcements into a molded structure and of the achievement of smooth surfaces after overcoming numerous difficulties. Problems involved in structural arrangements are shown to have been solved by the provision of material in sufficient amount and at the correct positions to take the forces imposed on wings and fuselages. Consideration of stringers and stringer spacing and grain direction of veneers in fuselage construction conclude the present article. *Aviation*, December, 1942, pages 146–149, 315, 6 illus.

Plastics Classified. W. L. Morse. The writer classifies and briefly describes the many types of commercial plastics, avoiding as far as possible reference to chemical terms. The two main groups of plastics are designated as thermosoftening and thermosetting. The general characteristics of each are outlined and information on the plastics in each group is furnished. Recent applications of plastics are discussed. *Aeronautics*, December, 1942, pages 32–34, 1 illus.

Design Fundamentals for Phenolics. J. A. Petho. An investigation of plastics for structural applications made because of the increased demand for materials needed in the war. It is explained that laminated or molded fabric-base phenolic plastics were recognized as offering great possibilities of solving structural problems. Another advantage of these plastics is pointed out to be their low specific gravity. A table is furnished showing a comparison of the strength of phenolic materials with that of aluminum. In considering the characteristics of phenolic plastics, it is concluded that design based on knowledge of the material is essential for a successful installation. Information is furnished on the molding of plastic parts. *Modern Plastics*, December, 1942, pages 77, 78, 142, 144, 11 illus.

Acid and Alkali Resistance of Plastics. John Delmonte. A current investigation is given of the resistance of plastics to acids and alkalis. A wide range of acid and alkali concentrates were employed and a qualitative examination was made of their effect on plastic materials at various intervals. The progress of chemical attack was determined by noting the changes in the physical properties of the plastics. The corrosive agents used, the materials tested, and the results of the tests are enumerated. *A.S.T.M. Bulletin*, December, 1942, pages 11–15, 7 illus.

Machining "Lucite." A series of photographs portrays certain methods peculiar to the machining of plastics such as Lucite. Illustrated are machines and handling techniques employed. *Aero Digest*, December, 1942, pages 194, 195, 11 illus.

Planes of Paper. Some information is revealed regarding a plastic made with a paper base which, it is stated, may prove to be a revolutionary factor in aircraft construction. It is explained that the paper used in the process is made from a special and readily obtainable wood pulp. After the paper is impregnated with a special phenolformaldehyde resin, it is ready for molding. Because of the war, details of the plastic's composition and production are being withheld. Preliminary laboratory tests are said to indicate the new plastic has a much higher tensile strength than that of any paper-laminated plastic heretofore produced.

Ack-Ack guns that "see, hear, and think"

MEN who man our anti-aircraft batteries swear that their ack-ack guns can "see, hear, and think." Here's why:

In case of a night air raid, the first ears to hear the enemy bombers are mechanical ones in the Sound Locator developed and continually improved by Sperry. Far more sensitive and reliable than human ears they can locate enemy planes while they are still many miles away and determine their exact position and the direction of their flight.

When the "ears" have found the planes, the "eyes" of the ack-ack guns take over. A battery of 800 million beam candle-power searchlights, the most powerful in the world, spotlights each enemy raider *automatically*. So brilliant is the light of this Sperry invention that a man miles away can read a newspaper by it.

While the reaching finger of the searchlight follows the plane across the sky, the "brain" of the guns goes to work. This is another Sperry device, the Universal Director.

Working many times faster than the human mind, this uncanny instrument calculates firing data and transmits them to the anti-aircraft guns electrically. Then a Sperry power control mechanism automatically positions the guns on the target.

The last act in this amazingly swift-moving drama comes when the men slam home the shell and press the firing lever. Which they do. And enthusiastically!

Creating "eyes, ears, and brains" for anti-aircraft guns is but one of the many ways in which Sperry is co-operating with our Army and Navy, and helping through precision engineering to solve the problems of a nation at war.

Sperry Gyroscope Company, Inc.
Brooklyn, New York
Division of Sperry Corporation

SPERRY

PRECISION ENGINEERS TO AMERICA

Light equipment can be used for molding it. Possible uses for the plastic are described. *Modern Plastics*, December, 1942, pages 82, 130, 3 illus.

Making Plywood with Multidirectional Pressure. John S. Barnes. Information is furnished on the characteristics and manufacture of molded plywood. The writer describes how simple and compound shapes are formed. Problems of forming compound-curved surfaces are discussed. It is explained that in the manufacture of plywood parts a fundamental knowledge of wood technology is essential. Pressure calculations are presented and discussed. Reference is made to new resins that give full-strength bonds. Consideration is given to the necessity for further development of molding technique. *Mechanical Engineering*, January, 1943, pages 17–20, 5 illus.

Plastic Bond for Wood Blades. The characteristics, applications, and advantages of Hydulignum are outlined. Effective for propeller laminations, this is a wood material utilizing thermoplastic resin as a bonding medium. The article states that the density of Hydulignum compares favorably with metal and like materials because with suitable heat-treatment under pressure the density at the blade root is raised to as much as 82 lbs. per cu.ft. One of the possibilities afforded by the use of Hydulignum is interchangeable blades of one propeller design. *The Aeroplane*, November 27, 1942, page 627, 2 illus.; "Hydulignum Blades in a Plastic Bonded Wood Material for Airscrews," *Aircraft Production*, December, 1942, page 730.

Improved Techniques Promote Expanded Use of Plastic Parts. Kenneth Woodson. Procedures instituted by Consolidated Aircraft Corporation for large-scale substitution of plastic parts are related. At the inauguration of the program a list of airplane parts thought suitable for plastic application was established. Among the criteria determining this were the following considerations: whether the part would be adaptable to plastic molding; how much strain it would have to withstand; and what type of material would be suitable to withstand various service conditions, such as extreme temperature changes, resistance to abrasion, vibration, and possible flexing. *Aero Digest*, December, 1942, pages 126, 276, 2 illus.

Forming and Repairing Acrylic Plastics. D. S. Frederick. The writer describes methods used in the forming and repair of acrylic plastics. Sections of the article cover heating the material, forms for acrylics, emergency field forms, simple forming, stretch forming, and male and female forming. *Modern Plastics*, December, 1942, pages 86–89, 138, 10 illus.

Private Flying

What about the Night? William D. Strohmeier. Stating that the limitation of private flying to daylight operations is impeding its progress, the writer discusses the various problems connected with night flying. He makes several suggestions as to how these problems can be solved. Navigation, collisions with other planes, obstructions, bad weather, engine failure, and landings are the topics dealt with.

The availability of a twin-engined airplane with respectable single-engined performance is indicated as one essential in promoting the practicability of private flying at night. Objections to such a plane—on the grounds of cost, difficulty of handling, etc.—are refuted. The possibilities of the helicopter are mentioned. A more elaborate lighting and airport system, as well as improved lighting of the airplanes themselves, is advocated. Other recommendations include: development of more adequate electrical systems for private planes, tricycle landing gears, and rate of climb and bank and turn indicators as standard equipment. *The Sportsman Pilot*, December, 1942, pages 16, 17, 43, 50, 2 illus.

Production

White Floors Light Those Under-Wing Shadows. Light-reflecting floors made with white cement are offered as an economical solution to the problem of efficiently bringing an adequate amount of light to the undersides of wings and fuselages when the airplane is in production. Explaining the reflection values of floorings, the writer gives the advantages of white floors as compared with darker ones. A survey is reported which shows that by sending 61 per cent more light beneath wings and 20 per cent more on vertical faces, white flooring makes seeing easier and quicker, reduces accidents and errors, and improves aircraft quality and production. In addition, it is claimed, one company that has installed white floors in its assembly plant will effect a $30,000 first-year saving in lamp fixtures, maintenance, and power. Boeing, Consolidated, Douglas, and North American are four examples given of aircraft companies that have white floors in their plants. *Aviation*, December, 1942, pages 166, 167, 301, 302, 305, 4 illus.; "Increasing Plant Illumination by the Use of White Cement Floors," *Aero Digest*, December, 1942, pages 234, 288, 289, 3 illus.

Sharing Ideas. A report on the impressions of members of the United States missions sent to Britain to examine aircraft production methods in that country. Among other things, the series of comments touches upon the employment of greater numbers of women in England, the dispersal of factories, labor relations and arrangements, wood propeller blades, and complementary production between the two countries. Members of the mission included T. P. Wright, P. G. Johnson, and J. Carlton Ward. *Aircraft Production*, December, 1942, page 709, 1 illus.; "American Mission" *Flight*, December 3, 1942, pages 600, 601, 10 illus.

DeSota Builds Bomber Fuselages. Franklin M. Reck. The Chrysler DeSoto Division's production procedures for building bomber subassemblies are examined and their plant facilities are described. Details are given on fixtures and equipment. In accordance with its automobile-building background, DeSoto divides the work of aircraft construction into as many subassemblies as it can, leaving as little work as possible for the final assembly. A plan of labor specialization is also followed; wherever possible the worker is limited to one or two operations. *Aero Digest*, December, 1942, pages 188, 191, 192, 7 illus.

Chemicals that Aid in Aircraft Production. Ray Sanders. With the object of generating ideas and stimulating thought on a few basic fundamentals, rather than attempting to blanket the wide field of chemicals used as an aid in the processing of metals for aircraft construction, the writer concentrates on a small number of protective treatments and cleaning methods and their equipment. A comparison is made of the chromatizing, phosphatizing, and anodizing processes. It is pointed out that the primary purpose of these treatments is protection against, and passivating of, highly reactive metals to render a surface suitable for paint adhesion. After studying the results of exposure tests made by the United States Army Air Forces to determine the relative adhesion of paints to certain aluminum alloys, it is decided that comparable results will be obtained with each of the above-mentioned treatments and that these are

High Precision

The enormous striking power of America's eager, fighting planes comes largely from the amazing accuracy of their hundreds of precision parts.

Prominent among these parts are the smooth rolling Hyatt bearings into which we build great capacity while holding them true to required precision tolerances.

Ranging from hyper-quality large engine crankshaft bearings to relatively smaller super-smooth bearings for superchargers, Hyatt precision products faithfully serve the nation through the aircraft industry.

But, aviation is not the only field in which Hyatt Roller Bearings are battling the Axis.

Their proved performance under battle conditions in tanks, guns, ships and trucks . . . their round-the-clock operation in factories, on farms and railways . . . all reflect the many advantages of their high precision manufacture.

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

well ahead of ordinary cleaning methods. Emulsion degreasing, vapor degreasing, mechanical washing machines, and auxiliary washing tanks are discussed. Information is furnished which emphasizes the importance of temperature control. Consideration is given to the differences in cleaning and treating methods employed with aluminum and magnesium alloys. The preparation of steel, copper, or brass for cadmium plating, and of aluminum alloy for spot welding is described. Discussing new developments, the writer tells of a phosphoric compound that contains no aggressively active acid or virulent poison, to replace hydrofluoric acid, and of a compound in jelly form for the treating of sections too large to submerge in solution, which is painted over the areas to be spot welded. *S.A.E. Journal*, January, 1943, pages 23–30, 12 illus.

Modification Centers Hold Key to Mass Output, Officials Believe. The article presents some important aspects of the modification center plan, which, it is believed, may bring the aircraft industry closer to maximum production. It is explained that the plan permits up-to-the-minute developments to be incorporated in combat aircraft without interrupting the flow of production and may have an important bearing on the future. The information is obtained from the War Department's Bureau of Public Relations. *American Aviation*, December 15, 1942, page 50.

Assembling and Testing P-40's in Burma. Byron A. Glover. From his participation in the activities, a Curtiss-Wright test pilot reports how P-40 fighters were assembled and test-flown in Burma for the American Volunteer Group. He depicts the difficulty of the conditions under which the work was done and tells of the methods devised for utilizing native labor, available equipment, and existing facilities. The actual assembly procedure is detailed, operation by operation, as is the flight testing routine. Descriptions are given of the airport where the testing took place and of the assembly building and area. *Aviation*, December, 1942, pages 96–103, 320, 323, 11 illus.

The Walrus Amphibian. Finale of a two-part article dealing with the production processes of the Walrus amphibian. This installment treats of its spar assembly, the building of its wings, and the construction and assembly of its typical control surfaces. In conclusion, the methods employed in the manufacture of the Walrus' fuel and oil tanks are reviewed. *Aircraft Production*, December, 1942, pages 710–715, 18 illus.

An electric hoist, installed especially for women workers, is now being used by Wright Aeronautical Corporation for shifting finished parts to conveyor lines.

Formability of Aluminum Alloys Used in Aircraft Fabrication. Given A. Brewer. In this article on aluminum-alloy sheet-metal forming it is emphasized that because different forming operations impose different loading conditions on the metal crystals, the behavior of the crystals is different for each of the operations. For this reason it is difficult to prove any one alloy to be more formable than another. The writer discusses the manufacture of parts formed by bending up flanges from a sheet, which involves simple bending operations, and the production of lightening hole flanges and internal flanges in which there is stretching as well as bending. The forming of contoured skins for fuselage and nacelle coverings also is discussed. Consideration is given to the ability of a material to shrink without buckling, which increases with the thickness. *Automotive and Aviation Industries*, December 15, 1942, pages 32–35, 12 illus.

Wings for Victory. . . . Made in Canada. Several articles are devoted to individual accounts of the production activities of various Canadian aircraft companies. They recount their accomplishments and expansions during the past year, describe their facilities, touch upon their histories, list their officers and department heads, and relate what airplanes or parts they manufacture. The subjects of the articles are: Noorduyn Aircraft Ltd., Canadian Car & Foundry Co. Ltd., Fairchild Aircraft Ltd., de Havilland Aircraft of Canada Ltd., Fleet Aircraft Ltd., Boeing Aircraft of Canada, Federal Aircraft Ltd., Aircraft Division of Canadian Vickers Ltd., the Ottawa Car & Aircraft Ltd., and MacDonald Bros. Aircraft Ltd. *Canadian Aviation*, December, 1942, pages 50–66, 71, 72, 74, 76, 98, 100, 52 illus.

Heat-Treating Aircraft Engine Parts. The installation of a separate heat-treating department at the plant of the Packard Motor Car Company for large-volume heat-treating of Rolls-Royce aircraft-engine parts is described. Production-line technique is being applied to this work, which is usually regarded as a "custom job." The unit is equipped to do carburizing, hardening, drawing, nitriding, cleaning, and inspection of steel parts, as well as performing stress-relief operations on some parts made of aluminum and steel. The writer's description follows the material from its receipt in the department, with details on the processes to which it is subjected. The furnaces and other equipment are discussed, as well as the devices installed for handling the material and moving it through the various operating sections. *Aviation*, December, 1942, pages 171, 173, 327, 328, 331, 6 illus.

Reducing to Produce. The Bristol Aeroplane Company's system of salvaging materials is described. Emphasis is placed upon the fact that nothing is wasted and that every possible bit of material is regenerated. *Flight*, December 3, 1942, pages 610–612, 6 illus.

Britain Pours Out Planes. Sir Charles Bruce Gardner. The chairman of the Society of British Aircraft Construction reports on the progress of aircraft production in Britain since the beginning of the war. He states that the development has resulted not merely in increased output but also in the rise of a new engineering technique, record expansion, training of hundreds of thousands of men and women, instruction of ancillary industries, and the creation of new materials. He predicts that the near future will bring a period of close technical and manufacturing cooperation between Britain and America. *Canadian Aviation*, December, 1942, pages 102, 104, 3 illus.

Quality Control Plays a Major Role at Bendix. Joseph Geschelin. Highlights are presented of the flexible manufacturing setup of the Bendix parent plant, where aircraft landing gears are being produced. It is explained that this plant is unique in being both a manufacturing organization for the production of many different sizes and types of landing gears and a development center for the conception of new, improved designs and the establishment of suitable production procedures. An examination is made of the nature of the manufacturing problems involved after which production techniques are described. *Automotive and Aviation*

AERONCA LIAISON PLANES RELY on SCOTT

Maneuvering on roadways and other restricted landing areas calls for extreme skill of the pilot. Contributing to this skill, Scott Steerable Full-Swivel Tail Wheel Assemblies respond with positive action, guiding the Army's efficient Aeronca Liaison Planes to safer take-offs and landings. ★ ★ Built to take the abuse of emergency service, Scott Tail Wheel Assemblies combine exceptional lightness and strength. Each Scott Tail Wheel Assembly is static-tested for shock resistance to guarantee dependable performance under the most exacting ground conditions. ★ ★ Scott Tail Wheel Assemblies are part of an ever-expanding line of special equipment for the air services—equipment which includes oxygen manifolds ... oxygen regulators ... brake pressure units ... control wheels ... stabilizer yokes ... rudder horns ... aileron bell cranks and Scott-Cast "40-E" aluminum alloy castings. Your inquiry on special equipment will receive prompt and confidential attention.

Scott
AVIATION CORPORATION
LANCASTER, N. Y. U.S.A.
DESIGNERS AND MANUFACTURERS OF SPECIAL EQUIPMENT FOR THE AIRCRAFT INDUSTRY

SUPPLIERS TO THE U. S. ARMY AND NAVY AIR FORCES AND LEADING AIRCRAFT MANUFACTURERS

Industries, January 1, 1943, pages 18–23, 44, 12 illus.

Boosting Bomber Production by Subcontracting. T. J. Dunnion. The Glenn L. Martin Company's subcontracting system is outlined. The writer reviews how subcontractors who formerly were engaged in the manufacture of a variety of unrelated products were incorporated into the system until now they are responsible for nearly 40 per cent of the construction work on Martin bombers. Noting briefly how these subcontracting plants are found and geared for airplane production, he describes the job of the expediting staff which not only expedites parts and materials but also assists subcontractors with problems relating to tools, engineering, and priorities. *Aviation*, December, 1942, pages 221, 223, 225, 227, 2 illus.

Merry-Go-Round Fixture Speeds Press Loading. W. S. Clark. By means of a redesigned hydropress, Vultee Aircraft has facilitated the output of miscellaneous sheet-metal parts so that it is now possible for two men to produce 10,000 parts on one machine in eight hours. The writer describes this machine as a redesigned conventional rubber-pad press incorporating the uninterrupted-cycle principle of operation. To the press has been added a turret table that can be indexed to either two or three stations. With this arrangement, one station can be taken up by unloading; a second, by loading; and the third, by pressing. *Wings*, December, 1942, page 260, 1 illus.

Save Materials, Money, Time. A group of pictures illustrates some examples of economies effected by the Canadian aircraft industry. These exhibits were selected from a recent display at Toronto for war plant executives. Figures are quoted on the material, time, and money saved by each. *Canadian Aviation*, December, 1942, page 113, 4 illus.

Ford Builds Gliders. At a former station wagon plant the Ford company is building transport gliders designed by Waco. In addition to giving a brief description of the glider, this article notes several mass-production ideas that have been incorporated in its manufacture. Chief among these is the breaking down of the work into a number of subassemblies, a method used in automotive line production. *Aero Digest*, December, 1942, 236, 237, 298, 8 illus.

Boeing. In this article the writer describes what is being accomplished in the production of Waco-designed gliders at the Wichita plant of the Boeing Airplane Company and tells how ingenuity and close cooperation between aircraft producers have aided America's glider production program. *Dixie Air News*, December, 1942, pages 13, 24, 1 illus.

"Erector Set" Assemblies Speed Production With Unskilled Labor. R. P. Gaylord. How the aircraft industry is now using production methods capable of a high production rate yet suited to a relatively low order of skill is presented. The Arizona Division of the Goodyear Aircraft Corporation has solved a production problem by means of "erector set" assembly. With this system, coordinated tooling under loft control provides parts and jigs to assembly departments. The writer explains how corrugated floor sections are made with coordinated tools and templates. *Wings*, December, 1942, pages 266–268, 6 illus.

Was Warplane Production Bungled in 1942? Dorothy Rockwell and James Yates Newton. Some comments on what has been accomplished in American warplane production during 1942 are supplemented by notes on projected plans for 1943. The writers explain some of the duties constituting the jobs of Charles E. Wilson and Ferdinand Eberstadt, executives of the War Production Board. Mr. Wilson, the vice-chairman in charge of production, is at present concentrating on the increase of aircraft output. Mr. Eberstadt, vice-chairman on program determination, is charged with the responsibility of coordinating the production program with the supply of available materials.

Among the factors mentioned in the article are the Controlled Materials Plan and the Aircraft Board. The figure of 45,000 planes is quoted for the estimated output of 1943, with an accent on heavier airplanes. In defense of the wide variety of plane models being manufactured by the United States, it is stated that this is necessary because we are fulfilling a greater diversity of war requirements than any other country. A review of the performance records of American fighters and bombers is included. *Skyways*, January, 1943, pages 16, 19, 76, 81, 2 illus.

Propellers

Propellers in the Making at the Nash-Kelvinator Plant. Joseph Geschelin. Highlights of manufacturing operations in the production of automatic variable-pitch propellers at the Nash-Kelvinator plant are presented. The flow of materials is arranged in conformity with straight-line mass-production methods. Details of materials handling are outlined. Reference is made to the close machine tolerances used which makes parts interchangeable. Plant equipment is described in considerable detail. *Automotive and Aviation Industries*, pages 20–25, 72, 74, 19 illus.

Rotating Wing Aircraft

Billion Dollar Baby. Esther H. Forbes. A description of the VS-300 helicopter is supplemented by a record of its performance in test flights and a review of Sikorsky's early experiments with helicopters. Indicated advantages of this type of aircraft include simple controls, safety devices, low cost, and economical maintenance. Its possibilities are depicted for military adaptation as well as civil flying. Sikorsky is quoted by the writer in an analysis of the helicopter's qualities and in a prediction of the extent to which it will be used after the war. *Southern Flight*, December, 1942, pages 28–30, 4 illus.

Stress Analysis

The Design of Trusses and Its Influence on Weight and Stiffness. Jean Drymael. The writer shows that a proper choice of design may improve both the weight and stiffness of trusses. He develops a method for choosing the best among several statically determinate designs and then demonstrates that when a redundant truss has to carry one set of loads it is always possible, by the removal of some bars, to get a statically determinate truss that is lighter for the same ultimate stress. He further shows that the redundancy retains its advantages when the structure has to carry several sets of loads in turn. *The Journal of the Royal Aeronautical Society*, December, 1942, pages 297–308, 3 illus.

The Photoelastic Analysis of Transverse Bending of Plates in the Standard Transmission Polariscope. D. C. Drucker. In this paper it is shown that the application of ideas of three-dimensional photoelasticity to the analysis of the stresses in plates under transverse bending results in a simple photoelastic method, employing the standard two-dimensional transmission polariscope. The method of procedure employed is to "freeze" a fairly high initial tension in Bakelite or similar material, cut out the model at the same angle to the direction of the tension, bend, and observe. Test

FROM PINS TO SOCKETS in the same Cannon Plug

Interchangeability of parts—always an important factor in the Cannon line of electrical connectors—means real benefits for the user of these precision plugs and sockets. Hundreds of shapes and sizes with a large selection of insert arrangements in most sizes make it possible to use a standard Cannon Connector for many highly specialized applications.

So wide is the selection in the Cannon line that it is difficult to find a requirement in the aircraft, radio and heavy industrial fields which cannot be met with a stock Cannon product.

Cannon's standardization of parts that may be freely interchanged has contributed to greater speed on aircraft assembly lines, faster service in the field and uniform performance under all types of conditions.

WRITE FOR CANNON PLUG MANUAL—*A copy of "Cannon Plugs For Aircraft Electrical Circuits" will be mailed to you if requested on your business letterhead. This 76-page book, profusely illustrated in color, shows how Cannon Plugs are made and how they are used throughout aircraft industry.*

CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles, California

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto, Canada

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

results are presented. Photographs of two cases, the circular hole and the semicircular notch, are shown. Stress-concentration factors are obtained and analyzed. Brief consideration is given to the problem of the thick plate as contrasted with the thin plate assumed in the usual theory. *Journal of Applied Mechanics*, December, 1942, pages A-161–A-164, 8 illus.

Repeated Flexural Stress (Fatigue) Test. Information is presented on test procedure for determining the effect of repetitions of stress on plastics by a fixed-cantilever type of testing machine. The machine is designed to produce the same deflecting of the specimen in each cycle. It is explained that this test is also applicable to plastic-impregnated wood and plastic-bonded plywood. The article is published by permission of the American Society for Testing Materials. *Modern Plastics*, December, 1942, pages 95, 96, 132, 134, 136, 138, 4 illus.

Experimental Determination of the Isostatic Lines. Augusto J. Durelli. The writer describes a direct method for obtaining isostatic or stress trajectories. The technique consists in covering the surface of the body with a thin coat of lacquer that becomes brittle upon hardening. It is explained that if the object being tested is painted under zero load and then stressed after the coating has hardened the layer of lacquer will crack along lines perpendicular to the maximum tensile strain. The companion set of trajectories at right angles can usually be formed through relaxation. As the procedure eliminates the necessity for determining the isoclinic lines, which are difficult to determine, it is believed to offer great possibilities as an aid in photoelasticity. The procedure can be applied almost without regard to the geometric form of the object under stress and possesses the advantage that the test is nondestructive. *Journal of Applied Mechanics*, December, 1942, pages A-155–A-160, 14 illus.

Built-in and Continuous Beams. Leslie P. Dudley. In this paper a discussion of relevant theorems leads to the development of Clapeyron's Theorem of Three Moments. One purpose for which this theorem can be used to particular advantage is in estimating the crankshaft bearing loads in a nonradial engine. Attention also is drawn to Wilson's method of solving continuous-beam problems, which produces results identical with those given by the Theorem of Three Moments. *Aircraft Engineering*, November, 1942, pages 306–309, 319, 8 illus.

Buckling of Rectangular Plates with Built-In Edges. Samuel Levy. This paper deals with the problem of buckling by compressive forces in one direction of a rectangular plate with built-in edges (zero slope, zero displacement in the direction normal to the plane of the plate). The writer presents an exact solution to the problem in terms of infinite series. The buckling load is calculated for 14 ratios of length to width, ranging in steps of 0.25 from 0.75 to 4. On the basis of convergence, as the number of terms used in the infinite series is increased, it is estimated that the possible error in the numerical results presented is of the order of 0.1 per cent. *Journal of Applied Mechanics*, December, 1942, pages A-171–A-174, 2 illus.

Lagrangian Frequency Equations. J. Morris and J. W. Head. The writers present another method for the solution of Lagrangian frequency equations. The method is essentially one of stepping up in degree. Since the roots and modes at any particular stage are found precisely in terms of the roots and modes of the preceding stage, the method is not based on any form of approximation. *Aircraft Engineering*, November, 1942, pages 312–314, 316.

Brittle Coatings for Quantitative Strain Measurements. A. V. de Forest, Greer Ellis, and F. B. Stern, Jr. Consideration is given to the use of brittle coatings in stress analysis. The writers discuss the "Stresscoat" materials and method, which can effect quantitative analysis within the elastic range by the use of brittle coatings alone. In the plastic range it is shown that flaking off of the coating is caused by a compression component of strain of about 1 per cent. The effect of such variables as coat thickness, time of dry, temperature and humidity, creep, and bubbles in the coating is shown by graphs and illustrations. *Journal of Applied Mechanics*, December, 1942, pages A-184–A-188, 13 illus.

Superchargers

High Altitude Power. A brief outline of the development of the supercharger is presented and a description is furnished of the different types of aircraft superchargers in current use. These include the single-stage direct-drive supercharger, the two-speed gear-driven supercharger, and the exhaust-driven turbosupercharger. Information is furnished on a recent German design of a hydraulically driven supercharger that is rotated by lubricating oil from a dry-sump system. *Aero Tech*, November, 1942, pages 36–38, 7 illus.

Testing

Mechanical Testing. Based upon a bulletin issued by the Northern Aluminum Company Ltd., this article surveys the bearing of mechanical testing upon the working properties of aluminum and aluminum-alloy products. Some of the tests discussed are those for ultimate tensile stress, 0.1 per cent proof stress, percentage elongation on standard length, percentage reduction of area, and hardness to penetration (of ball or diamond). Other tests covered by the article are those dealing with Erichsen cupping test value, bend test value, shear stress, and notched bar impact value. *Aircraft Production*, December, 1942, pages 720–723, 10 illus.

Testing Equipment

Power Recovery in Testing Aircraft Engines. C. A. Chayne. Information is furnished on the test equipment for aircraft engines used at the Buick plant, particular attention being given to the feed-back system for power recovery. Pointing out that aircraft engines must be delivered to the plane manufacturer in a thoroughly run-in condition, the writer goes on to explain that the three fundamental types of test equipment are the propeller house, absorption dynamometer, and feed-back system. Details of the feed-back system are described. Information is given on the approximate per cent of the horsepower-hours developed by the engines on test which is converted into electric energy and fed back to the plant power supply lines. *Automotive and Aviation Industries*, December 15, 1942, pages 26–28, 84, 86, 7 illus.; "Testing Aircraft Engines," *National Aeronautics*, December, 1942, pages 29, 47, 1 illus.

Stress Measurement. K. R. Boydell. Information is furnished on a type of strain gauge apparatus for determining the stresses in aircraft propeller blades, which is being used experimentally in England. In leading up to a description of this apparatus, reference is made to the previous use of carbon resistances that are "strain sensitive" for determining strains in propellers. The resistance of these carbon resistances varies in proportion to the strain applied. The writer describes the new technique in which a flat coil of wire that is similarly strain sensitive is employed. It is explained that these wire resistances are cemented to the blade. Any resistance change will cause a variation in an alternating current, and this variation is magnified by means of a valve amplifier and recorded by an oscillograph camera on a moving film. The analysis of records and the determination of steady stresses is discussed. *Aircraft Production*, December, 1942, pages 687–689, 5 illus.

Tools and Equipment

Ingenuity Spreads Skilled Labor in Canadian Die Making. N. F. Vanderlipp. An explanation of the tooling policies and working methods followed by Fairchild Aircraft Ltd. Although certain standard types of tools are adopted for similar types of work and existing equipment is used whenever possible, the tool-design policy is one of extreme flexibility. Because of the shortage of experienced toolmakers, they are used for layout only, with unskilled workers carrying out each planned operation. Tooling is divided into five groups—sheet metal, machine shop, service systems, miscellaneous (wood, fabric, plastics, etc.), sub- and final-assembly jigs, and fixtures—each under the control of an expert.

The article includes a group of nine illustrations showing various tools. Among them are cast Kirksite dies and Masonite form blocks, which, easily produced, help to compensate for the shortage of skilled toolmakers. *Wings*, December, 1942, pages 257–259, 9 illus.

A Quick Cheap Way of Making High-Speed Steel-Tipped Tools. C. B. Ericson. Consideration is given to problems connected with the salvage and repair of worn out high-speed steel tools. A method of producing common types of high-speed steel tools, which was developed in the welding department of the Sullivan Machinery Company, is described. Illustrations of various tools aid the reader in understanding how the repair work is carried out. *The Welding Journal*, December, 1942, pages 834, 835, 6 illus.

Spar-Boom Milling. Outlining the advantages to be gained by the machine's use, this article offers a study of the LZ2 Wadkin spar miller's construction and operation. Employed for milling the components of the Avro Lancaster bomber, the LZ2 can machine a maximum length of 30 ft. One of its features is a mechanical copying arrangement that permits a wide range of gap milling and step milling to be carried out.... either as a separate operation or combined with curved or tapered profiles. Repetition of such operations can be effected automatically. Principal dimensions of the spar miller are listed. *Aircraft Production*, December, 1942, pages 701–704, 6 illus.

INSTITUTE *of the* AERONAUTICAL SCIENCES
1932-1943

Since its incorporation in October, 1932, as a scientific membership society to advance the art and science of aeronautics, the Institute of the Aeronautical Sciences, in over ten years of service to aviation, has become the representative technical society for the aviation industry and profession. It is the only organization in the United States which brings together all of the sciences and branches of engineering and technology which are applied to aeronautics.

Activities

In this year, coincident with the great increase in aeronautical production and research in the nation's war effort, the Institute is expanding its membership and activities in keeping with the greater demands made upon its services. Beginning with aeronautical students, the Institute has increased the number and activities of Student Branches. Members of the Institute in aeronautical centers are organized in local Sections which hold their own meetings. More of these Sections are being formed this year and additional services provided for members. The Annual Meeting and other national meetings provide forums where specialists in all the aeronautical sciences may present and receive reports on progress made in their particular fields and learn of developments in other fields that have a bearing on their own work. All meetings are held with proper safeguards to prevent any unauthorized publicizing of important information. Several annual awards and honors are conferred by the Institute to recognize and encourage outstanding achievement in the aeronautical sciences.

Publications

Papers presented at meetings or submitted to the Editorial Board are published in the Institute's two monthly publications—the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW. The JOURNAL prints in each issue several full length scientific papers on new research and developments in various fields applied to aviation. The REVIEW keeps members and subscribers up to date on aeronautical news and literature through reviews of new books and periodical articles, government publications and trade literature and will publish more papers on applied engineering and aircraft production.

Research Facilities

Through the Aeronautical Archives of the Institute, members have for their use the most complete aeronautical library and reference research facilities maintained by any technical society. At Institute headquarters in New York, the W. A. M. Burden Reference Library of books, reports and periodicals, the Aeronautical Index of subject files, biographic files and bibliography, and the historical and art collections in the Archives are available for study. The Pacific Aeronautical Library at 6715 Hollywood Boulevard, Los Angeles, maintains a reference collection and reading room for members and loans books to company libraries in the area. Through The Paul Kollsman Library, aeronautical books are lent by mail without charge to members anywhere in the continental United States. In addition to a very complete collection of standard aeronautical reference works, the Kollsman Library has available for loan new aviation books as they are reviewed in the AERONAUTICAL ENGINEERING REVIEW.

Membership

In addition to membership in professional societies representing their particular fields, specialists applying their knowledge and experience to aeronautics find membership in the Institute of great value in the contacts made with others engaged in aeronautical work and in the broad coverage of all aeronautical problems furnished through its meetings and publications. All applications for membership are carefully reviewed by the Admissions Committee, which recommends the grade of membership for which the applicant is found eligible. There are advanced grades of membership—Associate Fellow, Fellow, Honorary Fellow—to which members may be elected as their experience warrants. Thus, a member receives due recognition—more valuable because it is given by his colleagues—for his contributions to the progress of aeronautics. New applicants may be elected initially by the Admissions Committee to the grade of MEMBER if they are engineering graduates with at least three years of experience or have had over five years' experience in research, engineering, or other special work applied to aviation; to the grade of Industrial Member if they have acquired a recognized standing in an administrative capacity in the aviation industry; to the grade of Technical Member if they are recent engineering school graduates or are engaged in technical aeronautical work. For those who are not qualified for any of these classes of membership but who wish to receive certain of the Institute's services and publications, the grade of Affiliate is provided. Student Members are admitted by application through Student Branches organized at their schools. Aeronautical companies, as well as individuals, are affiliated with, and participate in, the support of the Institute through Corporate Membership.

Dues

An entrance fee of $5.00 is required of all new members who apply for admission to a grade of membership to be specified by the Admissions Committee (Corporate Members, Student Members and those who apply specifically for the grade of Affiliate being excepted). Annual membership dues, covering a subscription to the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW, for the various grades of memberships are as follows: Fellows—$20; Associate Fellows—$15; MEMBERS—$12.50; Industrial Members—$12.50; Technical Members—$7.50; Affiliates—$5.00 (covering subscription to the REVIEW only; for the JOURNAL and REVIEW, dues in this grade are $12.50). Dues of foreign members in all grades except Affiliates are $10.

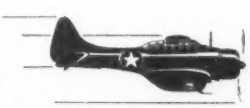
Those who are engaged in aeronautical work or who have an interest in any technical phase of aviation will find the services of the Institute to be a necessary aid in keeping abreast of developments in these times of such rapid progress. An application form and further information about membership can be obtained from an Institute member or by writing to the Secretary.

INSTITUTE OF THE AERONAUTICAL SCIENCES
1505 RCA BUILDING WEST
30 ROCKEFELLER PLAZA
NEW YORK

Pesco Fuel Pump
Standard Equipment
on Many Planes

Partners in victory, pilot and plane scream earthward to silence hell's fury. A life and a conquest are entrusted to the performance of thousands of parts . . . parts that *must* be perfect. It's our duty here at home to see that every part *is* perfect.

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .



PERFORMANCE POINTS TO Pesco **FIRST**

DIVISION BORG-WARNER, CLEVELAND, OHIO

Even on runways hacked out of the jungle

AEROL landings are always safe!

In today's global warfare, Aerol landing gear is serving on such diverse terrain as the steppes of Russia, the scorching sands of North Africa and emergency fields roughly hewn in the wilderness of the South Sea Islands.

In every case Aerols are performing superbly, insuring safe, smooth landings and take-offs that protect the plane and crew.

The splendid performance records now being established by Aerols on world-wide battle fronts are but a continuation of their earlier, peacetime accomplishments. Their success also offers sound evidence that Aerols will do an equally outstanding job in the almost limitless future of after-the-war aviation.

THE CLEVELAND PNEUMATIC TOOL COMPANY
AIRCRAFT DIVISION • • **CLEVELAND, OHIO**

Also Manufacturers of Cleco pneumatic tools for the aircraft and general industry, Cleco sheetholders, Cle-Air shock absorbers for trucks and buses, and Cleveland rock drills for mining and construction work.

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL" — THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

A new development at Lockheed is a high-speed air-driven router which trims off and trues up the skinned edges of the P-38 nose wheel well in the bottom of the fuselage. Formerly, every door was a hand-fitted job. This router, operating on tracks built into an insertion jig, now makes this opening uniform in every plane and eliminates hand fitting of the doors, which used to require many man-hours of work. (*See* "From the Industry.")

Training

Training as the Foundation of Air Power. The writer describes what he saw in a visit to the Empire Central Flying School. It is explained that Empire Central Flying School was founded in March, 1942, when it was found that the old Central Flying School was no longer adequate to deal with training and flying problems. The new school is a university of flight to which come chief instructors from the British Empire and also the United States. It is emphasized that a large aircraft production program must be accompanied by a balanced output of well-trained pilots and aircrew members. *Aeronautics*, December, 1942, pages 36–39, 11 illus.

CPT and the Navy. Capt. Arthur W. Radford. Indicating the value of preliminary training for prospective Naval aviators in C.P.T. schools, this article shows how the U.S. Navy's pilot recruitment has been facilitated by the C.P.T. program. It describes the aid that will be given Naval air training by the primary civil instruction of 30,000 students and secondary instruction of 10,000. Included is an outline of the available C.A.A.-C.P.T. pilot training for Army and Navy Air Forces. *Flying*, January, 1943, pages 20, 21, 132, 134, 4 illus.

Training Future Executives. Details are given on the Bristol Aeroplane Company's training program for potential executives and artisans. Three courses of instruction are in operation: the senior engineering course, student apprentice course, and the trade apprentice course. The article lists the qualifications for each of these. Schooling is divided into two classes—practical and theoretic—and wages are paid to the students. *Aircraft Production*, December, 1942, page 689.

How Our Navy Gears Pilots for War. Lt. (j.g.) Fred Tupper, Jr. A survey of the various steps and courses in the training of a U.S. Naval pilot. Each of the four phases of training are detailed: first, preflight; then, primary; next, advanced; and, finally, operational training when the pilot, already commissioned, is instructed in combat or patrol craft before being assigned to active duty. Entrance requirements are listed and an analysis is made of the purpose and technique of naval flying as compared with Army flying. *Aviation*, December, 1942, pages 239–241, 311, 6 illus.; "The Navy's Technical Schools," "*The Sportsman Pilot*, December, 1942, pages 18, 32; "Back-Seat Heroes," *Flying*, January, 1943, pages 55, 56, 147, 149, 1 illus.

Pre-Glider Training. Robert L. McIntyre. The course of preliminary training for U.S. Army glider pilots is described. Requirements are listed and facilities for training students are outlined. This program of instruction for initiating neophytes into motorless flying is executed by civil contract schools, employs civilian pilot instructors, and uses light planes for its purposes. Emphasis is placed on dead-stick work, but field patterns and various approaches are also taught. There are also supplementary ground courses in meterology, navigation, radio, theory of flight, aerodynamics, maintenance, and C.-A.A. regulations. *Flying*, January, 1943, pages 45, 46, 2 illus.

Training Female Labour. This article describes the training methods employed by Westland Aircraft Ltd., for the instruction of unskilled women workers. The syllabus of the school is divided into five main groups: an introductory course on tools, materials drawings, shop systems, plant practices, etc.; a capstan lathe course; a milling course; a drilling course; and a course in bench fitting and assembly. After a period of familiarization and preliminary theoretic instruction, each woman is fitted into the work for which she shows the greatest aptitude.

The article notes some of the special problems connected with the employment of women. It relates how, wherever possible, factory fixtures are designed especially so that they can be adapted for use by female labor. It includes a survey of a group of dispersal factories staffed wholly or largely by women. *Aircraft Production*, December, 1942, pages 690–693, 11 illus.

They Shoot for Keeps. Corey Ford and Alastair MacBain. Brief accounts are given of the training courses at Tyndall and Eglin fields, Florida. The former is the U.S. Army Air Forces' flexible gunnery school; the latter, the fixed gunnery school. While at Tyndall the student gunner is taught to fire the movable guns that protect bombers; at Eglin he is taught how to handle the stationary guns mounted in the wings of fighter planes. The article tells who is eligible for each course, describes each syllabus, and indicates the differences between offensive and defensive gunnery principles. *Collier's*, December 19, 1942, page 21, 1 illus.

Time Alone Doesn't Count. M. Berley Kittrell. The chief instructor of a primary Air Forces training center reviews several cases in which civilian pilots with a sufficient number of flying hours were unable to qualify as instructors for the Air Forces training program. Deploring the waste of necessary instructor material, he explains the reason for failure in each instance. It is indicated that the main cause is usually the pilot's lack of ap-

Creators and Makers of
ACCURATE RESISTORS—SWITCHES—SPECIAL EQUIPMENT AND
SPECIAL MEASURING APPARATUS FOR PRODUCTION AND
ROUTINE TESTING OF ELECTRICAL EQUIPMENT ON MILITARY AIR-
CRAFT... SHIPS... VEHICLES... ARMAMENT... AND WEAPONS
MEMBER
SAMA
SERVICE
Shallcross Instruments, Resistors and Switches are serving on many fronts. Why not put this record of service to work for you. Consult Shallcross on special electrical equipment. Perhaps our experience and engineering facilities can help you. Write Department C-8.
HALLCROSS MFG. CO.
COLLINGDALE, PENNA.

preciation for precise air maneuvers and his failure to set standards of perfection for himself. *Flying*, January, 1943, pages 49, 50, 145, 2 illus.

Army K.O.'s Stuporman. Col. Arthur I. Ennis. Urging the cooperation of the individual and stressing his responsibility in this respect, the writer discusses the importance of safety and caution during the aviation cadet training period. He describes the measures that have been taken by the army to minimize flying accidents. . . . the medical and physiologic tests undergone by cadets and the preventive medicine schedules covering their proper medical care, diet, rest, and recreation. He also explains the purpose of the Directorate of Flying Safety and tells something of how individual flying bases enforce their safety regulations. Figures are quoted on the decrease of the flying accident rate during recent years. *Skyways*, January, 1943, pages 26–29, 80, 7 illus.

A Glorious Achievement—Canada Producing World's Finest Airmen. An outline of the British Commonwealth Air Training Plan, with particular emphasis upon the part being played by Canada and the R.C.A.F. Details are presented on the structure of the plan, its financial support, and its achievements. In addition to mentioning the widespread fronts on which R.C.A.F. personnel are fighting numbers of citations that have been won by them are listed. *Canadian Aviation*, December, 1942, pages 78, 80, 82, 6 illus.

School for Bombardiers. Lt. Frank J. Rilling. Corollary to a description of the training phases through which U.S. Army Air Forces bombardier cadets go at the Advanced Flying School, Albuquerque, N.M., is an explanation of the bombardier's function in a plane. The course at Albuquerque begins with a three-weeks' period of ground training, is followed by several "dry runs" during which the student is familiarized with the working of the bombsight, and concludes with thorough drilling in actual operational practice. An analysis of different types of bombing—horizontal, dive, etc.—is included in the article. *Flying*, January, 1943, pages 52-54, 6 illus.

Something Old, Something New. Lt. Ken Lester. Notes are made on the features of an airplane which are new to an aviation cadet just entering the advanced phase of his training. The features discussed are retractable landing gear, flaps, manifold pressure gauges, constant-speed propellers, mixture controls, and carburetor-heat controls. *Air Facts*, January, 1943, pages 26–32, 36, 2 illus.

Wings of West Point. Capt. Burr

Leyson. This article reviews the course of air training received by a West Point cadet at Stewart Field where America's future staff officers are indoctrinated with a thorough knowledge of flying. Comparing Stewart Field's general flight training program with that of other Army training fields, it is explained that, while at other fields the student is concerned only with the operation of his plane, at Stewart he also studies the employment of air power and the principles of air strategy. The article also follows a West Point cadet, in the process of learning to fly, through a typical day's schedule. It stresses the great amount of work he has to do in an accelerated program that graduates him from the U.S. Military Academy in three years instead of four. *Skyways*, January, 1943, pages 40–43, 6 illus.

So You Want to Be a Gunner? Capt. Herbert O. Johansen. A story is presented on the training of aerial gunners. Various phases of the training program are described in considerable detail. *Air Trails*, February, 1943, pages 21, 52, 54, 1 illus.

Catapult Training. Supplemented by an account of a typical launching and recovery of a Walrus amphibian, this is a description of the five-day course of training given to British catapult personnel. Pilots, air crews, directing officers, aircraft personnel, handling parties, torpedo officers, electrical artificers, crane operators, catapult officers, catapult E.R.A.'s, and breech workers are instructed simultaneously....each learning his share in the process of launching aircraft by catapult and recovering them after landing. Several photographs illustrate the article. *Flight*, November 26, 1942, pages 573–577, 15 illus.

Aeronautics in High School. Charles I. Stanton. C.P.T. courses enabling high-school students to obtain private pilot's licenses are announced by the Administrator of the C.A.A. The program, essentially similar to those followed by the colleges, has already been established in 21 selected high schools. Training includes ground and flight courses and is administered by contracted flying schools. Data on qualifications of students and appropriation of funds for the program are given. *Flying*, January, 1943, pages 60, 120, 1 illus.

Those Flying Dutchmen. William Sprung. An article describing the Royal Netherlands Military Flying School at Jackson, Mississippi, and telling how hundreds of Hollanders and their Indonesian comrades have traveled thousands of miles to attend the school. War exploits of some of the officers who are training these men are related. *Air-Age*, February, 1943, pages 30–33, 62–64, 9 illus.

Warfare

The Third Year. Henry A. Bale. Comparative losses of the Royal Air Force and the Luftwaffe over enemy-occupied territory in Europe during the third year of the war are shown with the aid of a large graph. *Aeronautics*, December, 1942, pages 40, 41.

Welding

Correlation of Metallographic and Radiographic Examinations of Spot Welds in Aluminum Alloys. D. W. Smith and F. Keller. The writers emphasize the need for some correlation between the microstructural characteristics of spot welds and the features revealed by radiographic inspection. It is pointed out that development work on spot welding has been evaluated by metallographic examination. Because such methods involve sectioning of the samples, it is not suitable for routine inspection. It is stated that radiographic methods are nondestructive and should be capable of revealing many facts about the metallurgic characteristics of spot welds. In this paper the writers present a correlation between the two methods of examination. In addition, a description is included of the metallographic technique. *The Welding Journal*, December, 1942, pages 573-s–583-s, 11 illus.

Refrigerant-Cooled Spot-Welding Electrodes. F. R. Hensel, E. I. Larsen, and E. F. Holt. The paper covers an investigation conducted to determine some of the fundamentals of refrigerant-cooled welding electrodes. Experiments were confined to the spot welding of aluminum alloys. Comparative thermal conditions existing during spot welding, when using either conventional water cooling of the electrodes or refrigerant cooling, were investigated. Details of the investigation are described. *The Welding Journal*, December, 1942, pages 583-s–597-s, 39 illus.

Radiography of Spot Welds—II. Robert C. Woods, John C. Barrett, and T. W. Dietz. In this second and concluding article on the radiography of spot welds the writers present a combination of techniques that have given satisfactory determinations of the size and penetration of the fused weld nugget. Size is considered a fairly good indication of spot-weld strength. Sections of the article give information on how radiographs are made, selecting a film, checking weld nugget thickness, and how densities are measured automatically. *Metals and Alloys*, December, 1942, pages 1080–1083, 5 illus.

Arc Welding of Magnesium Alloys. W. S. Loose and A. R. Orban. The first part of this paper presents the general method of joining magnesium alloys by means of the Heliarc welding process. It also covers solutions to some problems encountered in production work. The second part of the paper deals with production methods used in the fabrication of magnesium aircraft parts. *The Welding Journal*, December, 1942, pages 598-s–607-s, 10 illus.

The Performance to Be Expected from Modified Resistance Welding Electrodes. S. H. Parsonage. Information is presented on the maintenance and proved performance of modified resistance welding electrodes. Methods of effecting economies of metal are outlined with reference to different types of welding apparatus and materials. *Sheet Metal Industries*, December, 1942, pages 1913–1916, 15 illus.

Effects of Cooling Rate on the Properties of Arc-Welded Joints in Carbon-Moly 0.50 Plate. Wendell F. Hess. In this investigation thermocouples were used to measure the actual thermal cycles of heating and cooling in the heat-affected zone of arc welds. The writer first describes the scope of the investigation and the equipment used. Information then is furnished on the preparation of the plates for butt welding and on the plate material used. Details of the study are then presented and the results are summarized. *The Welding Journal*, December, 1942, pages 608-s–619-s, 20 illus.

Electron Tube Control of Resistance Welding Machines. G. Higgins. The first of a series of articles presenting fundamental principles underlying electron tube control for resistance-welding machines. Information is furnished on the method of operating the various types of tube controls which have been developed for different welding applications. In this installment, eight points in favor of the electron-tube method over the more usual types of control are listed. The two principal types of electron tubes are described, the thyratron and the ignitron. A discussion of the principle of the resistance capacity timing circuit and of contactor timer control follows, with a description of the circuit operation. *Sheet Metal Industries*, December, 1942, pages 1917–1922, 9 illus.

FASTEST, FIGHTIN'EST PLANE "the Havoc"

The Douglas A-20 "Havoc" has been termed the most vicious, versatile airplane of the war. Also known in Britain as the "Boston," it is used as an attack bomber, torpedo bomber, night fighter, long range fighter, pursuit, interceptor, intruder. For three years the "Havoc" has been the scourge of the Axis on every front. And no enemy craft has yet matched it! So, America, your aircraft industry has out-designed and is now out-producing our enemies. Yankee ingenuity will win! Douglas Aircraft Company, Inc., Santa Monica, Calif.

DOUGLAS

Member, Aircraft War Production Council, Inc.

DOUGLAS BUILDS... BOMBER-FIGHTERS: THE A-20 "HAVOC" AND "BOSTON" • A-24 "BANSHEE" • SBD "DAUNTLESS" • TBD "DEVASTATOR"
WAR TRANSPORTS: THE DC-3 AND C-47 "SKYTRAIN" • C-53 "SKYTROOPER" • C-54 "SKYMASTER"

Government Publications

Civil Aeronautics Administration

Prevention of Idling Failures in Flight on 4-Cylinder Horizontally Opposed Engines. The records of the Civil Aeronautics Administration indicate that engine stoppages in flight resulting from idling difficulties are still persistent, and the material in this release is issued for the purpose of bringing under control further recurrences of this nature. This release supplements the Administration's Certificate and Inspection Division Release No. 36 (dated January 8, 1941) by emphasizing precautions during flight and in maintenance work that subsequent experience has indicated to be necessary and also includes reference to carburetor changes that have been necessitated by this type of trouble. Five such precautions are listed.

Recent changes in Bendix-Stromberg and Marvel-Schebler carburetors are listed which tend to reduce engine idling failures. *Safety Regulation Release No. 136*, November 24, 1942.

Changes to the Specification System for Aircraft, Aircraft Engines, Propellers, Appliances, etc. Numerous comments were received in the past from interested parties suggesting various changes to the specification system. As a result of these comments a questionnaire was sent to all Regional Managers requesting that their personnel comment on proposed changes to that system. Those comments have been received and are overwhelmingly in favor of changes that at present are being incorporated in each existing specification as it requires revision for other reasons. New specifications will be written in the new form for their first issuance.

Explanations are made of changes and improvements in the specifications with a view toward simplification and convenience. Six changes are listed, these referring to the use of serial numbers for the specifications, rearrangements of the sections, additions, and the elimination of the class system. The list is now subdivided into various headings as follows: propellers and propeller accessories (except deicing equipment), engine and engine accessories, landing gear and floats, electrical and radio equipment, interior equipment, deicing equipment, miscellaneous. *Safety Regulation Release No. 137*, November 30, 1942.

Altimeters. Amendment No. 121 to Section 60.4710 of the Civil Air Regulations requires that a sensitive type altimeter be installed in both air-carrier and nonair-carrier aircraft for contact flight operations on the airways. Some confusion has resulted among nonair-carrier operators regarding the desired accuracy and sensitivity of the instrument.

The Aircraft Engineering Division has completed a study of the situation regarding the availability of sensitive altimeters and, further, the specific requirements surrounding the desired accuracy necessary for flight level separation on the airways during contact flight operations. In view of the present airways regulation requiring a 1,000-ft. separation between aircraft except at crossings, where the separation margin is reduced to 500 ft., an attempt has been made to define three types of aneroid altimeters, the accuracies and sensitivities of which are such that each can be applicable for the intended type of flight operations mentioned in the Civil Air Regulations.

The information contained in this release relative to the desirable features decided upon for the respective types of aneroid altimeters is the result of a survey made among the major instrument manufacturers and within the Civil Aeronautics Administration. This survey bore in mind the acceptable scale-range tolerance values, minimum scale ranges, etc., that should be adhered to in the manufacturing of the three types of aneroid altimeters. In addition, it was deemed advisable to consider the standardization of scale ranges relative to the indicated altitude for each complete revolution of the tendency pointer. In this manner, regardless of the type of instrument installed or who the manufacturer might be, the scale range and also the limitations applicable for the type of flight operation will be signified by one of the three designations appearing on the dial.

In order that the three altimeters may be classified for the intended flight operations, explanations are presented which tend to define clearly the specific limitations in using a particular type of instrument. These cover the standard altimeter, which should be installed only in nonair-carrier aircraft for contact flight operations on and off the airways, and the sensitive altimeter, which should be installed in air-carrier aircraft for all types of flight operations and in nonair-carrier aircraft when instrument flight operations are intended on or off the airways.

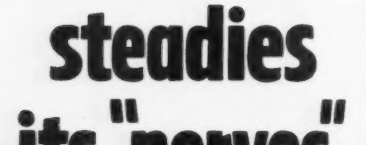
Installation instructions are appended. *Safety Regulation Release No. 139*, December 9, 1942.

How to Prevent Air Sickness. This booklet of 17 pages is a condensation of a larger report prepared by Dr. G. R. Wendt, of Wesleyan University, under whose direction the research was conducted. It contains a brief statement embodying suggestions growing out of research projects administered for the Civil Aeronautics Administration by the National Research Council Committee on Selection and Training of Aircraft Pilots. Causes of air sickness are analyzed and it is shown that the cure is to forget the sickness. Ways in which this may be accomplished are explained. It is demonstrated that fear is not the cause of air sickness. Suggestions are submitted for selection and training of prospective airmen, and advice is given for instructors.

Federal Security Agency

Scale Model Aircraft Construction Procedure. This booklet of 24 pages is divided into three chapters covering scale-model aircraft construction, inspection of model aircraft, and identification principles. It was prepared with the cooperation of the Navy Bureau of Aeronautics for use in connection with the Model Aircraft Project under which the schools of the nation were asked to make 800,000 scale-model airplanes for training purposes. The text discusses mate-

Industry steadies its "nerves"



FLUCTUATING line voltages are no problem in plants where Sola "CV's" take over. Power load surges may cause voltage variations as great as 30%, but the vital "nerve centers" of production lines continue to operate smoothly and with unerring precision.

Day and night, without care or supervision, Sola Constant Voltage transformers maintain positive control over electrically operated instruments and machines. These transformers are available in standard units with capacities ranging from 15 KVA, which can be used for an entire communications system, to the small 10 VA units for vacuum tubes. Special units can be built to meet unusual requirements.

Note to Industrial Executives: *The problems solved by Sola "CV" transformers in other plants may have an exact counterpart in yours. Find out. Ask for bulletin 9CV-74.*

SOLA Constant Voltage Transformers

SOLA ELECTRIC CO.

2525 Clybourn Ave. Chicago, Illinois

rials and methods for construction, details for checking the models for accuracy, and general information on what to look for when identifying aircraft. Drawings show construction details and identification points.

Navy Department

Graphic Management Control. The Bureau of Aeronautics of the United States Navy has published a set of control charts developed by an aircraft subcontractor in a form simulating control charts used in actual practice. By the use of such a system of charts it is possible to depict schedules accurately and to follow the progress of plant construction, engineering and releases, and material orders, and deliveries. Other functions aided by the system are tool design, orders and deliveries, parts manufacturing, subcontracting orders, schedules, and status of Government-furnished equipment.

To avoid loss of time in examining and discarding information of secondary importance, only vital data are included. The charts visualize clearly the needs of pressure at certain points to meet production schedules and the possibilities of relaxation of effort at other points.

A feature of this method of graphic management control is the running comparison between actual and forecast performance. Changes, improvements, or retrogressions are accentuated and the charts show vividly potential sources of difficulty or delay before the trouble becomes acute. *Bureau of Aeronautics*, Navy Building, Washington, D.C.

Office of Civilian Defense

Fire Bomb Fact Sheet. A résumé is presented of the characteristics of various kinds of incendiary bombs used by the enemy, with particular reference to the new types, some of which contain heavier and delayed-action explosive charges. Four types of German bombs and four types of Japanese bombs are described, with details regarding their size, weight, material, and manner of action. Information is added concerning protective cover for the fire fighter, methods of storing and dispensing water, ineffective measures no longer recommended, and a final caution relative to dealing with incendiary bombs. *OCD Publication 5209*, December, 1942.

War Department

Military Intelligence: Identification of U.S. Government Aircraft. This manual is intended to serve as a

A COMPLETE LINE OF AVIATION WIRE and CABLE by Wiry Joe

Wiry Joe, long a leading manufacturer of replacement wire and cable for the automotive industry, is also an important source of supply for electric wire and cable for the aviation industry.

The Wiry Joe "Aviation" line covers every need—starter cable, high-tension cable, primary cable—original or replacement. Wiry Joe also manufactures welding cable.

Every Wiry Joe "Aviation" cable is a quality cable, built to meet army and navy specifications, and produced under the Dostam Method of manufacture for high efficiency, long life, dependability and uniformity.

Inquiries concerning wire or cable for any type of service will be promptly answered.

Wiry Joe

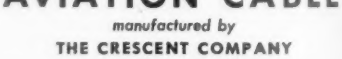
AVIATION CABLE

manufactured by

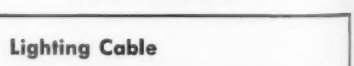
THE CRESCENT COMPANY

Pawtucket, Rhode Island

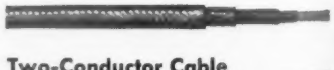
Lighting Cable



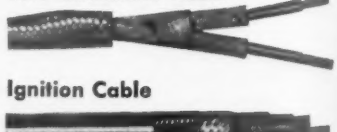
Two-Conductor Cable



Ignition Cable



Starter Cable



Available in both shielded and unshielded constructions

guide in the identification of all United States Government aircraft. Instructions are given in methods of identification and classification of airplanes, with definitions of the various types used by the armed forces. In the remaining pages there are photographs and silhouettes of each type of airplane in the service of the Army, Navy, and Marine Corps. *Basic Field Manual FM 30-30*, February 21, 1942, Superintendent of Documents, Washington, D.C., $0.25.

British Information Services

Parachute Corps. A booklet of 23 pages contains a description of the training, equipment, and functions of Great Britain's parachute troops. The high standards of physical and mental fitness required, the rigorous schooling, and the versatility of skills imparted to these supersoldiers are emphasized. Details are given on the ways in which the men are hardened and taught to jump with parachute, use weapons, fight unarmed if necessary, sustain themselves in a hostile country, and perform their hazardous tasks. Illustrations show many phases of the training and activities of these troops.

Transition in the Boundary Layer Caused by Turbulence. A. Fage. This paper discusses transition from laminar flow to turbulent flow in the boundary layer of a body caused by the turbulence in the free stream. A nondimensional number is derived, representative of the conditions in the boundary layer at transition, it being shown that this number should tend to have a definite value when the transition is caused solely by the isotropic turbulence.

Values of this number are calculated from the results of experiments made on flat plates, an elliptic cylinder, and a long streamline body of revolution in isotropic turbulent streams behind square-mesh grids. The average value of the number obtained is 0.985 and, of the six values calculated, four differ from the average value by ±6 per cent, one is 28 per cent greater, and one is 29 per cent smaller.

Calculations of the number are also made for two flat pieces and 13 airfoils in wind-tunnel streams. The conditions of flow in these streams are found to be diverse and to differ from those taken in the mathematical derivation. A representative value for these models appears to be 0.49. Ministry of Aircraft Production, Aeronautical Research Committee, *R. & M. No. 1896;* British Information Services, New York, $0.60.

Simplified Calculation of the Laminar Boundary Layer. V. M. Falkner. This paper describes a method for the practical calculation of the surface friction, momentum thickness, and displacement thickness of any two-dimensional laminar boundary layer. It is said to be superior to Pohlhausen's method in accuracy, time required, and simplicity. It is based on standard solutions published previously by the author, its accuracy and simplicity being demonstrated by calculating two known solutions, the boundary layer of Schauber's ellipse, representing an airfoil, and a hypothetic case representative of a flat plate with pressure drop. The present application involves the use of one simple integral only, which is used in a simple relation to find an effective value that provides the data by which surface friction and momentum and displacement thickness are found directly from Table 10 of *R. & M. No. 1884* and Tables 5 and 8 of this report.

Another method is mentioned which allows a quick determination of the momentum thickness with no other data than a table of fluid velocity at the outer edge of the boundary layer against the distance along the surface of an airfoil measured from the stagnation point. This alternative method can be used instead of the original solution when the latter, in exceptional cases, results in partial failure through insufficient range of the tables provided. Ministry of Aircraft Production, Aeronautical Research Committee, *R. & M. No. 1895;* British Information Services, New York, $0.90.

An experimental Investigation of Wind Tunnel Interference in the R.A.F. 5 ft. Open Jet Circular Tunnel. J. E. Adamson. A report is submitted of tests that were required to check the validity of the theoretic corrections for wind-tunnel interference in the 5-ft. opening tunnel when the wing is of large span or spans the jet. The investigation comprised tests of two wings of 8-in. chord and 1-ft. chord, which were tested on a horizontal diametric axis as follows: (a) spanning the 5-ft. open-jet wind tunnel and (b) cut down successively to 90 per cent, 80 per cent, and 60 per cent of the tunnel diameter. In all cases lift, drag, and pitching moment were measured. The following symbols are used in the text of the report: wing area, S; wing chord, c; tunnel diameter, d; tunnel cross-sectional area, C.

It is concluded, with respect to the wings inside the jet diameter, that for values of $S/C < 0.25$ and $c/D \leqslant 0.2$ the standard corrections may be applied. Beyond this limit it is found that further systematic tests are required to derive satisfactory empirical corrections. The author states that pending such tests it is better to calculate the slope of the lift curve in free air for the appropriate aspect ratio, using this to deduce the incidence corrections. In the case of wings spanning the jet, it is found that the corrections given by Glauert apply with a modified value and that further tests are required for larger ratios of the chord to the diameter. Ministry of Aircraft Production, Aeronautical Research Committee, *R. & M. No. 1897;* British Information Services, New York; $0.45.

Tests of Aerofoil N.A.C.A. 23012 in the Compressed Air Tunnel. D. H. Williams, A. H. Bell, and E. Smyth. A report is presented on tests of an airfoil designated as N.A.C.A. 23012, which is indicated as the most promising of a series of sections developed as an extension of the study of a family of airfoils in the variable-density tunnel. The N.A.C.A. 23012 section has a maximum chamber of approximately 2 per cent (actually 1.85 per cent) situated 15 per cent aft of the leading edge with the usual N.A.C.A. 12 per cent thick fairing, the maximum thickness occurring at 0.3c. The centerline is straight from a point just behind the position of maximum camber to the tail. This model is designed to have a small pitching moment and a high maximum lift. The profile is held to be superior to R.A.F. 34 in that the minimum profile drag is lower.

The N.A.C.A. 23012 section was tested over a range of Reynolds numbers in a variable-density tunnel and in the full-scale tunnel of the National Advisory Committee for Aeronautics. The section was also tested in the compressed-air tunnel over the complete range of Reynolds numbers available in order to test its properties independently, and results from the three tunnels are compared. It is concluded that agreement is good at high Reynolds numbers, taking the "effective" Reynolds numbers for the variable-density tunnel. The very high maximum lift coefficient (1.61) observed in the variable-density tunnel was not obtained in the compressed-air tunnel, where the highest value was 1.49. The maximum lift values obtained in the compressed-air tunnel and the full-scale tunnel are in good agreement. Later measurements on the airfoil with a 15 per cent split flap at 90° have been included. Ministry of Aircraft Production, Aeronautical Research Committee, *R. & M. No. 1898;* British Information Services, New York, $0.60.

This U. S. Air Corps AT-10 developed by Beech Aircraft Corp. is a modern example of stressed skin structures made of Haskelite Aircraft Plywood; and designed for mass production.

24 Years of Developed HASKELITE ENGINEERING MODERN PLYWOOD

The Haskelite that is used for today's planes is as modern as the ships themselves.

Since World War I when Haskelite was a prime source of aircraft plywood, engineering research has created new uses for Haskelite materials by constantly improving their quality and uniformity.

If your ideas of plywood are of the 1918 vintage, it may pay you to learn where and how the products of this company are being used today.

HASKELITE MANUFACTURING CORPORATION, Dept. AE-4302, 208 W. Washington St., Chicago, Ill.
7310 Woodward Ave., Detroit, Mich. • 405 Lexington Ave., New York, N. Y.

HASKELITE

AIRCRAFT PLYWOOD

Plymetl Phemaloid

Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York, N. Y.

Aeronautical Yearbook

Each year this all-comprehensive work becomes increasingly valuable by the addition of new sections. This year there are excellent biographic sketches of the leaders in military and naval aviation and articles by Cy Caldwell and Lucien Zacharoff. The sections on aircraft, aircraft engines, and armament are remarkable for their world coverage considering present restrictions. The statistical section gives general information as to organizations, personnel, airports, C.P.T., pilots, and air transport, with an especially complete listing of American and foreign firms making aircraft products. It is a veritable mine of useful information for the aircraft industry.

Aerosphere, 1942, edited by Glenn D. Angle; Aircraft Publications, New York, 1942; $12.50.

Air Navigation Primer

Written to provide an introduction to the study of air navigation by young men and women who are expected to take up aviation as a vocation in later years, this book is offered as a basis for more advanced study. The material on aerial astronomy is brief and is included for the purpose of emphasizing the importance of this branch of the science and its methods of solution of problems of position.

The chapters set forth in nontechnical language explanations of navigation, latitude and longitude, measurement of position, instruments, maps and charts, piloting and radio bearings, dead reckoning and the wind triangle, the radio-range system, and flight instruments and corrections. Questions follow each chapter and are reprinted with the answers at the end of the book.

Air Navigation for Beginners, by Scott G. Lamb; The Norman W. Henley Publishing Company, New York, 1942; 103 pages, $1.50.

Aviation-Education Text

This book, offered as a basic text in the aviation-education program, is designed to aid the student in developing those skills and abilities essential to a course in preflight or ground-school aeronautics. The text provides the student with material for practice in the manipulation of symbols, terms, and abbreviations. Realistic problems, each of which is an independent exercise, are presented. The appendix contains prognostic exercises, as well as drills reviewing skills and abilities that may have become atrophied through disuse. It also contains a group of "long-term" problems that call for definitions, formulas and diagrams to be added in a cumulative manner as the course progresses.

Aeronautics Workbook, by Cornelius H. Siemens; Ginn and Company, New York, 1942; 174 pages, $1.00.

Aeronautical Definitions Illustrated

This dictionary is unquestionably the most useful guide to aeronautical terms yet published, as it illustrates most of the definitions with informative drawings. Although 2,057 illustrations are used, which add materially to the explanatory notations, there is no attempt to cover the entire glossary of aeronautical terms. The book will be used more as a pictorial instruction dictionary than as a reference work where the less frequently used technical expressions are given.

Prepared by a group of technical experts who write accurately on aeronautical subjects, under the direction of one of the most experienced pilots, the definitions can be regarded as authoritative. The terminology used in elementary meteorology, radio, chemistry, and navigation is included.

To make the dictionary even more helpful the "slanguage" used at flying fields is given. Especial credit is due to the artists who drew the sketches to clarify the definitions. By themselves they would give fascinating interest to any book on aeronautics.

Jordanoff's Illustrated Aviation Dictionary, by Assen Jordanoff; Harper & Brothers Publishers, New York, 1942; 415 pages, $3.50.

Parachute Facts

In writing this book, the authors have assumed that the reader has no previous knowledge of parachutes. Knowledge is imparted in easily understood language. Reasons for the use of the parachute, which is termed the life preserver of the air, are set forth, and the history of its development is briefly outlined. Military parachutes are discussed. Following chapters cover parachute operation, design and construction, packing the parachute, and inspection maintenance and repair. The final chapter describes the employment of parachutes to land fire fighters in remote timber areas.

Parachutes, by Major Gen. James E. Fechet, Joe Crane, and Glenn H. Smith; National Aeronautics Council, Inc., New York, 1942; 123 pages, $1.00.

Radio Engineering

This book represents an engineering treatment of radio as applied to avigation and communication. After presenting special factors of aeronautical problems, the author discusses in detail each of the nine radio facilities used in modern transport practice. Consideration is given to special performance, installation, and servicing factors influencing the design of these facilities and to engineering fundamentals and methods that have been developed for handling them. Intended for those who already have a preliminary knowledge of radio and understand the terms used in describing the characteristics of apparatus, the book is divided into four parts, the first of which presents an introduction to applications of radio to aeronautics. The following parts cover avigation, communications, and accessories. There is an appendix on mechanical requirements for aircraft radio equipment.

Principles of Aeronautical Radio Engineering, by P. C. Sandretto; McGraw-Hill Book Company, Inc., New York, 1942; 414 pages, $3.50.

It's New!

Aluminum-Coated STEEL

FOR AIRCRAFT PARTS

From ARMCO Research comes a *new* specialty sheet metal—ARMCO Aluminized Steel.

This *aluminum-coated steel* is well suited for aircraft parts, including fire walls and air-intake filters. It combines the surface-advantages of aluminum with the strength of steel.

In tensile, yield, impact and fatigue strength, ARMCO Aluminized Steel gives you the values of its mild steel or copper-bearing steel base. It has exceptionally good resistance to heat and corrosion. The corrosion resistance is due to the formation of a tight, self-healing oxide film on the aluminum coating. This coating is resistant to "pin-holing."

ARMCO Aluminized resists heat discoloration up to 1000°F., and withstands severe oxidation at higher temperatures. Aluminized may be painted, but in most cases the surface is satisfactory. After the war it will be available in a finish that can be buffed to a bright luster.

The aluminum coating clings firmly in moderate drawing and forming operations.

You can buy ARMCO Aluminized in either sheets or coils, with a choice of these base metals: low-carbon steel or copper-bearing steel. Gage limits are 14 to 28. Write The American Rolling Mill Co., 211 Curtis St., Middletown, O., for prices and information.

MADE OF ★ ARMCO ★ ALUMINIZED STEEL

THE AMERICAN ROLLING MILL COMPANY

Advice from a Flight Surgeon

Many books written by physicians presuppose a knowledge of medical terminology and therefore are not understandable to the lay reader. This book is written primarily for the guidance of pilots and will render a valuable service. The author, from his experience as a flight surgeon, gives advice that will convince any pilot of the necessity of having competent medical supervision.

The value of rest and exercise is stressed. The effects of flying on the pilot's heart, eyes, ears, nose, and throat are explained. The chapter on dissipations is written from the point of view of a friend and not a prude.

The use of psychology in determining the fitness of pilots is outlined, but the ramifications are not detailed. Tropical aviation, Arctic aviation, first aid after accidents, altitude effects, and a list of diseases every pilot should know are all discussed.

Ralph Damon in a foreword states that he believes if Horace Greeley were alive today he would say: "Go up, young man, go up." But before any young man proceeds far in his flying career he would do well to read Dr. Kafka's book.

Flying Health, by M. Martyn Kafka; Military Service Publishing Company, Harrisburg, Pa., 1942; 248 pages, $2.00.

Elementary Text on Engines

One of a series of books on air training, this small volume is the result of the author's endeavor to present a general picture of the aircraft engine by an explanation of the development and functioning of the internal-combustion engine and a description of the operations and characteristics of various components such as the carburetor and ignition apparatus. Intended primarily for the novice in the study of aeronautical power plants, it attempts only to create a general picture. Particular details have been intentionally omitted to avoid confusion, but such details can be placed in the student's mind after the basic framework has been acquired.

For this reason, only passing reference is made to the theory of the heat engine, since, in the author's opinion, such theory can be mastered more readily after a practical visualization of the engine has been attained. After introductory chapters that explain the fundamental principles of the operation of the internal-combustion engine, the subjects of carburetion, supercharging, ignition, fuels, lubrication, and construction are discussed.

Aero Engines, by D. Hay Surgeoner; Longmans, Green and Company, New York, 1942; 110 pages, $1.25.

Tale of an R.A.F. Fighter

A story of an R.A.F. pilot from babyhood to the age of 23, with intimate details of his personal life and his work as a fighter pilot. Born since the first World War, the author is already a veteran of the present conflict, having been wounded and shot down in France in 1940. He was shot down again in the Battle of Britain and spent a year in a hospital. Undaunted, he is back in service once more, piloting his Hurricane in the Far East.

The narrative is typical of that of many young men of the Royal Air Force who are characterized by tenacity, disciplined subordination to a tradition, and a brotherly devotion to each other and their duty.

The Way of a Pilot, by Barry Sutton; Macmillan & Company, Ltd., London, 1942; 117 pages, $1.50.

Avigation Fundamentals

Written especially for aircraft flight crews, this book on the principles of navigation is intended for the student and instructor in the classroom and for use in drafting-board periods. The material was not prepared for home study. The course is divided into group sections, each of which corresponds to about one hour of lecture. The subject is presented in a manner that should enable the inexperienced student to acquire a good fundamental knowledge of aerial navigation. Diagrams and charts are used extensively throughout the text to aid the student in understanding the principles set forth. After each explanation, classroom and example problems are provided.

Navigation Principles, by Elbert F. Blackburn; Airlines War Training Institute, Washington, D.C., 1942; 219 pages.

Fundamentals of Meteorology

For the increasing number of young people who are becoming interested in aviation as a career, this book is intended to provide an introduction to the study of weather conditions as they apply to flying. Planned for such a purpose, the study avoids the consideration of meteorology as a highly technical subject but treats it from the standpoint of the application of common sense to observations that can readily be made.

The student is encouraged to make such observations as he can and to interpret them in the form of a weather forecast in accordance with the principles set forth in the text. If this practice is carried out regularly and earnestly, the author shows that the percentage of correct predictions will increase and the wrong guesses will become less frequent.

The subject is developed by a consideration of the composition and action of the air, climate and weather, instruments, winds, clouds and their causes, and air masses. Instruction is given in making weather maps and interpreting them, and a chapter is devoted to facts and figures to be remembered. The book concludes with a series of questions and answers.

A Start in Meteorology, by Armand N. Spitz; The Norman W. Henley Publishing Company, New York, 1942; 95 pages, $1.50.

Aircraft Layout and Detail

Intended as a transition course for men who already have had training in some branch of engineering, this book consists of a series of lessons covering phases of aircraft drafting-room practice. Sufficient information on aircraft materials and fabrication methods is presented to enable the student to make clear drawings that will show how parts must be manufactured. Prepared as a result of experience in the training of draftsmen within the plants of the Douglas Aircraft Company, Inc., the text represents an amplification of a course on drafting standards presented at the University of California. Much aircraft drafting information has become standardized, and this standard information is given throughout the book. In presenting this course the writer has chosen practical examples from aircraft construction. Drafting assignments, which consist of making production drawings of typical airplane parts, are arranged so that the student can apply the knowledge gained in the preceding part of the text.

Aircraft Detail Drafting, by Norman Meadowcroft; McGraw-Hill Book Company, Inc., New York, 1942; 211 pages, $2.25.

Trigonometric Function Tables

In this volume the author presents tables of trigonometric functions to seven places, by thousandths of a degree. The tables will make possible the more extensive use of calculating machines in astronomic, geodetic, and optical computations. The wide use of calculating machines for these purposes has been prevented by the lack of tables giving values of trigonometric functions to many places. The basis of computation is Gellibrand's Trigometria Britannica, Goudae 1633.

Seven-Place Values of Trigonometric Functions, compiled by J. Peters; D. Van Nostrand Company, Inc., New York, 1942; $7.50.

To do these important jobs better...

AiResearch offers the U. S. a new power-conserving *Exhaust Heat Exchanger!*

INSTALLED AS A part of the exhaust pipe, this featherweight AiResearch unit does not weigh much more than the section of pipe it replaces.

This new AiResearch Exhaust Heat Exchanger causes little back pressure and power loss. In fact, pressure drop in the exhaust pipe remains about the same as before installation of unit.

The AiResearch Heat Exchanger is made from corrosion-resistant steel. Simple in design, it requires no auxiliary equipment, is therefore less vulnerable to mechanical failure.

Good news? You bet! For it provides a way to do these two important jobs better than ever before:

Cabin-Heating — Air from the Exhaust Heat Exchanger is passed through an intercooler, warming the counter-passing air to the cabin *without danger of carbon monoxide contamination.*

Flame-Damping—The AiResearch Exhaust Heat Exchanger can be kept in constant use for cooling exhaust gases . . . preventing their igniting as they leave the turbo. *And with practically no loss of engine power* because this unit does not materially affect exhaust back pressures.

The assistance of our AiResearch engineers is offered in applying the advantages of this new-type Exhaust Heat Exchanger to specific problems. Inquiries are invited.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES, CALIFORNIA
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does the Job"- Automatic Exit Flap Control Systems
Supercharger Aftercooling Systems • Engine Air Intercoolers • Engine Oil Cooling Systems

A Year of Aviation Progress

Each year a former and a present aviation editor of the *New York Times* bring an ever growing group of readers up to the minute by a readable review of current aviation progress. The outstanding photographs of the year are surrounded by text that will give to anyone the state of aeronautics as seen by two keen and informed observers. Military, commercial, and intercontinental transport, training, and the development of airports are not overlooked. It is an informative book, which will give enjoyment to the general reader and also please the specialist because of its accuracy.

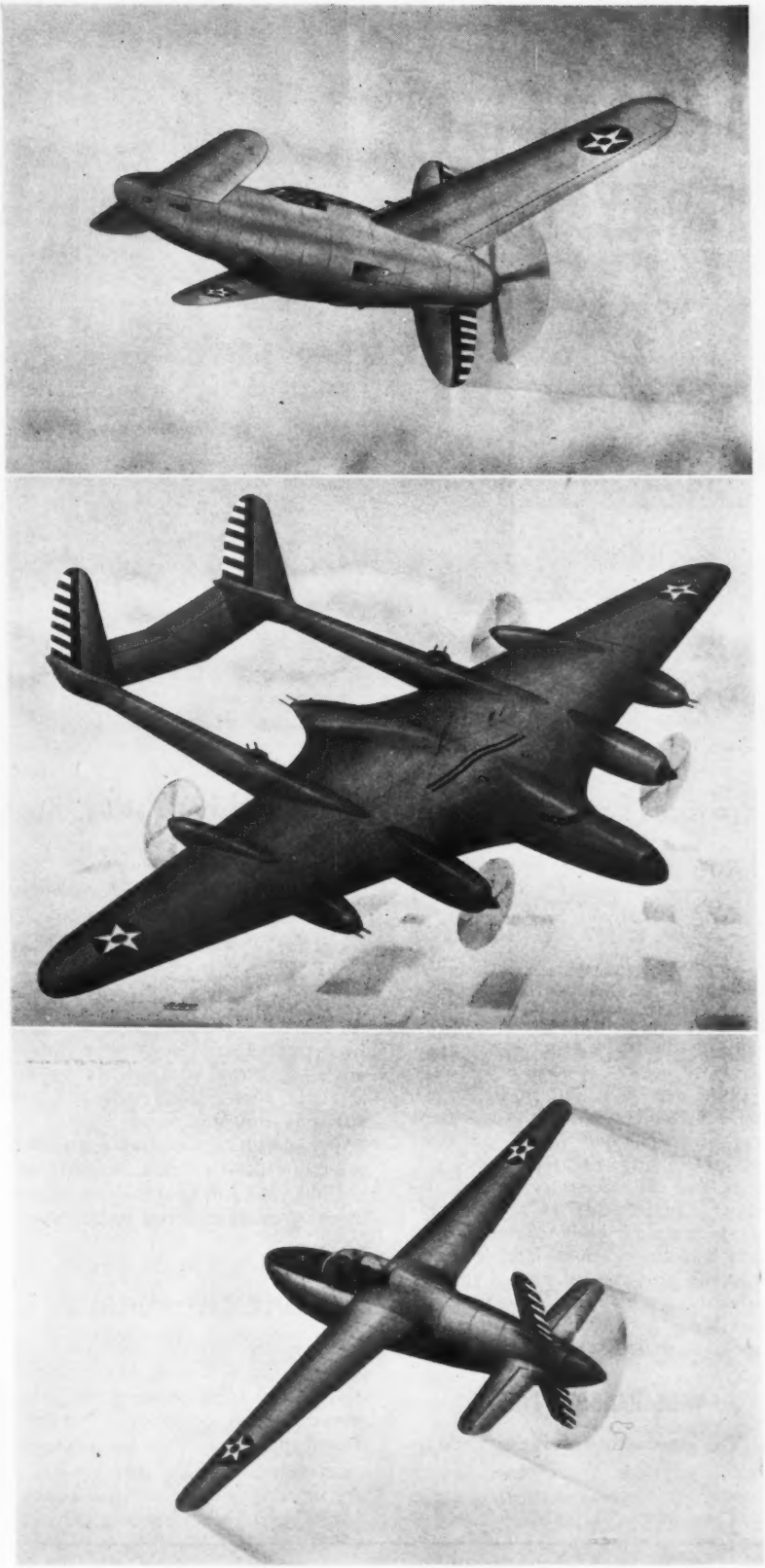
Although the present volume is similar in treatment to its predecessors, this is a completely new book containing information about the many activities that have developed from the war. Among other things, it covers the meaning of air power, Army and Navy training, glider troops and paratroops, civil and military air transport, the results of applying mass production technique to the building of aircraft and engines, and a look into the future of air traffic.

Young America's Aviation Annual: 1942–1943, by Reginald M. Cleveland and Frederick P. Graham; Robert M. McBride & Company, New York, 1942; 254 pages, $2.50.

Aircraft Radio Fundamentals

The principles of radio are set forth in a book prepared especially for aircraft flight and ground crews. The book is not intended as a home study course, having been written for the student and instructor in the classroom. Radio principles are taken up step by step, examples and classroom problems following each subject discussed. It is obvious that this method of presentation has been adopted by the author in order to impart to the inexperienced student a sound fundamental knowledge of a complex subject. Explanations are clearly presented in simple language. An examination of the subjects covered reveals the broad nature of the course, which opens with the principle of vacuum tube operation and continues with a discussion of radio and audio frequency amplification and amplifiers, transmitters, aircraft transmitter output coupling, and frequency indicators. Other sections cover the superheterodyne receiver, the transmission of radio waves, static, fading, direction finding equipment, and trouble shooting.

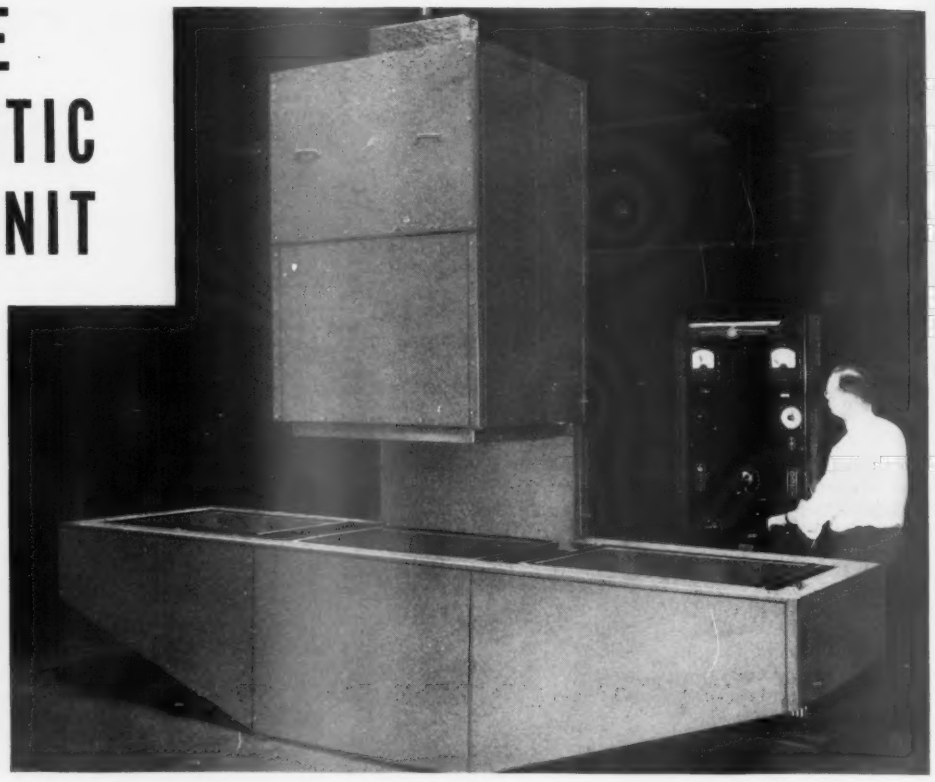
Radio Principles, by John W. Stone; Airlines War Training Institute, Washington, D.C., 1942; 139 pages.



Reproduced from Young America's Aviation Annual: 1942–1943

These three sketches were made by Air Forces' engineers and illustrate conceptions of possible planes for the future.

NEW G-E AUTOMATIC X-RAY UNIT



Provides Fast, Economical Production-Line X-Ray Inspecton of Light Metal Castings

Designed expressly to speed up x-ray examination of aluminum and magnesium castings, the new G-E Automatic Industrial X-Ray Unit provides a full solution to the problem of the foundry or manufacturer faced with the inspection of large numbers of such castings or assemblies during each working shift.

COMPLETE, SELF-CONTAINED UNIT

The new G-E Automatic Industrial X-Ray Unit incorporates an x-ray unit enclosed within an x-ray proof housing, a tray conveyor system, and the necessary control devices. Installation is a comparatively simple matter since no auxiliary lead-lined rooms are required and the unit can be placed to best advantage with relation to material handling facilities and other inspection processes.

WIDE RANGE of POWER

The automatic unit is designed to incorporate any one of four different G-E x-ray equipments as an integral part. Units operating at voltages ranging from 30,000 to 250,000 volts are available, and the selection of the x-ray unit which will do your job best is determined by the type of material to be examined.

SIMPLE, EASY to OPERATE

Unusually simple and easy to operate, the G-E Automatic Industrial X-Ray Unit requires only the services of two operators. No personnel problem will be encountered since special technical training is not required.

Like all other G-E Industrial X-Ray Units, this new automatic equipment is backed by more than 20 years' experience in the design and construction of industrial x-ray apparatus for all types of applications.

For complete details call in an experienced G-E Industrial X-Ray Engineer. You can rely upon him to give you facts and figures that will save your time, insure peak production examination, and help you protect your x-ray investment. Write or wire, today. Address Department N 82.

Today's Best Buy – U. S. War Bonds

GENERAL ELECTRIC X-RAY CORPORATION

2012 JACKSON BOULEVARD CHICAGO, ILLINOIS

Weather Prognostication

This contribution differs from the usual book on meteorology in that it is devoted almost exclusively to the principles and problems of weather forecasting. It is intended to give a new approach to the subject and to present methods of procedure not before generally available. Short-period forecasting technique is stressed, but techniques of the Five-Day Forecasting Project of the United States Weather Bureau at Washington also are covered. The author's treatment is particularly concerned with forecasting based on data from a single station rather than from a network of observation posts. This single-station technique is said to be particularly valuable under war conditions where information from a network of observation posts frequently is unobtainable. The book contains new sets of maps and charts drafted especially for the project.

Basic Principles of Weather Forecasting, by Victor P. Starr; Harper & Brothers, New York, 1942; 299 pages, $2.75.

Fundamentals and Problems of Fighter Design

The public has been confused when it has read that this or that fighting plane was the "best in the world." Anyone who reads this book will be convinced that such a claim cannot be made for any one plane. The author, who is assistant director of research of the United Aircraft Corporation, explains in terms that are understandable to the layman how compromises must be made in the design of any fighter plane to take advantage of optimum performance from propellers, engines, wing loading, and streamlining. The maximum speed at high and low altitudes, rates of climb, maneuverability, and stability are all examined and illustrated by excellent drawings. The book will help to clear much foggy thinking about performance of aircraft.

Fighter Facts and Fallacies, by John G. Lee; William Morrow and Company, New York, 1942; 63 pages, $1.25.

Air-Borne Bacteria

Although this book does not refer to the transmission of microorganisms by airplane, it will give the flight surgeons and operators of air lines between countries a clear idea of the extent of airborne infectious disease bacteria. Navy specialists contributed chapters and the book may be considered a standard work on the subject.

This volume consists of two parts, extramural aerobiology and intramural aerobiology. There are eight papers in the former and 29 in the latter. The symposium was presented at the meeting of the American Association for the Advancement of Science, held in connection with the celebration of the fiftieth anniversary of the founding of the University of Chicago.

Aerobiology, edited by Forest Ray Moulton; American Association for the Advancement of Science, Washington, D.C., 1942; 289 pages, $4.00.

Aspects of Cancer Study

The project covered in this volume has two major aspects, the adaptive response of normal animals to reduced pressure and the effect of reduced pressure on tumors. It is explained that the cortico-adrenal aspect was added while the work was in progress, as it formed a connecting link between the two original aspects of the work and did much to unify them. The primary purpose of the investigation was the study of cancer. A considerable portion of the book is devoted to climate with special reference to reduced pressure, which in this particular investigation is used as the tool for the study of cancer. The first part of the volume describes this tool.

The book is divided into six sections. These cover the general organization and technical proportions for the project; the adaptive response of normal rats to atmospheric rarefaction; the effect of reduced pressure on the viability of animal tumors; the effects of reduced pressure on some nontumorous forms of disease; adaptive relations between low pressure and cancer and some other agents; and conclusions reached.

The Adrenal Cortex in Adaptation to Altitude, Climate and Cancer, by Edward S. Sundstroem and George Michaels; University of California Press, Berkeley and Los Angeles, 1942; 409 pages, $4.00.

Handbook of the Armed Services

This handbook of military information for civilians, enlisted men, and officers explains how and where services of civilians can be best used by the armed forces. It follows the routine of induction, enlistment, commissioning and promotion and gives advice on the procedure to be followed in each case. The physical and mental standards required are outlined. The pay of all ranks, with possible extras, is shown with information as to how advancement may be secured by study in the various schools conducted by the Services at universities, flying schools, or at Army or Navy posts.

The opportunities for women in the armed forces and in civilian programs are fully explained.

The Army, Navy, Marine Corps, Coast Guard, Merchant Marine, and the civil aeronautics program each have chapters which are really subbooks, giving details of the possibilities of these Services. It is an encyclopedic guide to the armed forces of the United States, written to familiarize those who are now serving or expect to be called for participation in the war effort.

Opportunities in the Armed Forces, by Maxwell Lehman and Morton Yarmon; The Viking Press, New York, 1942; 418 pages, $2.95.

A Picture of the Armed Forces

A most useful book is offered not only for the prospective and actual soldier and officer but for the citizen as well. Written in question and answer form, it gives the information that is usually wanted about the various branches of the War Department, the Army, the Air Forces, the Navy, the Marine Corps, and the Coast Guard. Excellent bibliographies, glossaries including service slang, and insignia illustrations add to the usefulness of the book. The W.A.A.C. and W.A.V.E.S. also have their chapters.

It will enable our privates or newly commissioned officers to become acquainted with the functions of the Services with reasons why regulations are as they are.

Army-Navy Guide, Foreword by Brig. Gen. George A. Herbst; Crown Publishers, New York, 1942; 320 pages, $1.50.

Manual on Diesel Engines

This book is intended to be an introductory text for pupils in vocational and industrial arts classes and for classes in internal-combustion engines of the Army, Navy, Coast Guard, and Air Forces in which general study of Diesel engines is to be followed by detailed instruction on specific engines. No attempt is made to include detailed instructions on all makes and types of Diesel engines. Examples of particular engines and equipment were chosen because they happen to illustrate and make specific the general descriptions of equipment now in use in the United States. After chapters on the theory of the Diesel engine and its fuel and combustion systems, there are chapters on construction, operation, maintenance, repairs, and overhauling. Instruments and auxiliary apparatus are also treated.

Services of the Aeronautical Archives of the Institute of the Aeronautical Sciences

The services of the Aeronautical Archives are available to all members of the Institute, to Corporate Members, to advertisers in the Aeronautical Engineering Review and, under usual library limitations, to the public. Four specialized services are available.

The Paul Kollsman Library

This lending library service makes available, *without charge*, the latest and more important aeronautical books.

As far as the facilities permit, any person in the United States over 18 years of age who can furnish references which certify to his or her responsibility may become a member of the library.

Members may request the loan of any aeronautical or technical book they wish to borrow. Through an exchange agreement with the Engineering Societies Library, any book on general engineering may be borrowed from its great collection of over 160,000 volumes.

A photostating service is available at usual library rates.

Applications for membership in the library and further information will be sent on request.

The Burden Reference Library

This reference library contains over 14,000 aeronautical books, magazines, pamphlets, photographs, reports, and clippings gathered from world-wide sources and is one of the most complete aeronautical libraries in the world. Material from this library is not available for loan but may be used for reference purposes at the Aeronautical Archives.

The Pacific Aeronautical Library
6715 Hollywood Boulevard
Hollywood, California

Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

The Aeronautical Archives Technical Information Service

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports, and general surveys of any aeronautical subject. Some of the available services are:

Bibliographies on any aeronautical subject.
Reports on any aeronautical subject.
Digests of aeronautical books, papers, periodicals, and references.
Translations.
Engineering investigations of special aeronautical subjects.
Biographies of individuals engaged in aeronautics.
Photostats of any aeronautical or general engineering material.
Microfilms made on special order.
Photographs made from the Institute's photographic collection.
Drawings and tracings made.

In addition to the services mentioned any commission which comes within the scope of the Service will be accepted. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers.

Reproductions of any material in the Aeronautical Archives of the Institute may be ordered at standard photostat rates.

INSTITUTE OF THE AERONAUTICAL SCIENCES
1505 RCA BUILDING WEST
30 ROCKEFELLER PLAZA, NEW YORK, N. Y.

Tonight's lesson for Japs

...subtracting Zeros

A great guy takes off, and a headline is in the making... a headline about courage and spunk and Army Bell Airacobras that help him shatter Jap Zeros into "kingdom come." From General MacArthur's Headquarters, Australia, October 12th (A. P.) comes news of the citation for "gallantry in action" of this Army Pilot:

...courage... ...an get.

Capt. Mainwaring was leading a flight of Airacobras over New Guinea on May 29 when one of his planes was attacked by eighteen Jap fighters. Turning back he shot down the leader of the enemy formation and scattered the others. He then reformed his own group and made a co-ordinated attack, destroying three more and possibly shooting down two others.

...AIR FORCE...

Under control of the Airacobra pilot is one of the world's hardest-hitting fastest-moving one man arsenals. Forward is a powerful cannon. Flanking him are heavy machine guns. Around him is protective armor and behind him is an outstanding record of Airacobra success in combat.

The day is coming when Allied Victory will end this war. An advanced world of air-borne commerce will follow. Then, all of our engineering skill and resources will turn from the needs of war to building planes for the needs of Peace. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

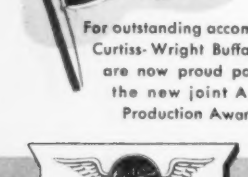
FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

WARHAWKS—Everywhere!

Wherever the enemies of democracy attempt to strike—in the Arctic's sub-zero wastes or the desert's blistering battleskies—Curtiss P-40 Warhawks are meeting and defeating every type of fighting ship they encounter. The world's finest combat pilots share credit for this remarkable record with the thousands of Curtiss workers who are building these world-famous fighting ships in quantities unprecedented in the annals of aviation.



For outstanding accomplishment, Curtiss-Wright Buffalo workers are now proud possessors of the new joint Army-Navy Production Award.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

Send 10¢ for "Men and Wings"—a fascinating 96-page history of aviation by Assen Jordanoff. Airplane Division, Dept. M., Curtiss-Wright Corp., Buffalo, N.Y.

FIRST
Since the Birth of Aviation

1932 • The first Curtiss plane designed specifically as a fighter-bomber . . . a single seater, it was used by the U. S. Navy for operation from aircraft carrier.

1937 • First fighter-bomber to use retractable landing gear—used by the Navy and by China, Argentina and Siam. Wing bombs were also carried.

1938 • The Hawk 75 . . . a monoplane fighter-bomber, incorporating heavier defense armament, increased maneuverability and carried a greater bomb load.

1940 • Curtiss P-40 Tomahawk . . . equipped the R.A.F. in the middle East and the American Volunteer Group in China, Java and Burma.

Although the book is largely devoted to industrial, marine, and automotive applications of Diesel engines, the principles are suitable for study by those interested in aeronautical uses for this type of power plant.

American Diesel Engines, by E. F. Goad; Harper & Brothers, New York, 1942; 313 pages, $2.75.

Disguise as a Protection

By means of text and numerous drawings, the author explains in nontechnical language the various methods of disguising objects for the purpose of deceiving enemies and protecting properties and people against attack, principally air attack. It is shown that there are three general methods—concealment, disruption, and mimicry—designed to make the enemy fail to see the object, to mistake the object for something different from what he seeks, or to distract his attention from the real object. The two principal divisions of the art of camouflage are set forth as concealment and confusion.

The use of color, shadow, texture, planting, coverings, structures, and other methods of disguise are discussed, and information is given on means for outwitting the enemy's aerial observation and aerial photography. Suggestions are also made on what should not be done, since some attempts at camouflage serve to attract attention and make the target easier to find. Although not strictly a part of camouflage, chapters are devoted to protective blankets, sandbags, and other means for lessening the effects of bomb explosions.

Camouflage Simplified, by Eric Sloane; The Devin-Adair Company, New York, 1942; 63 pages, $2.50.

Picture Book of Fighting Aircraft

Based on experience as a pilot and flight commander in the British air service in the first World War, as a squadron leader in the Royal Canadian Air Force in the present conflict, and as a commercial artist in peacetimes, the author has produced a book containing a collection of paintings of warplanes in flight. Each picture is in full colors and is accompanied by text giving a description and pertinent facts about the type of plane illustrated.

Current types of combat, observation and training airplanes of the United Nations and of the Axis powers are shown, including the Focke-Wulf and the Japanese Zero fighters. The endpapers of the book are utilized for the presentation of full-color reproductions of the wing insignia of the world's military and naval air forces. A page is devoted to a conventionalized outline drawing of an airplane, showing its principal parts.

Book of Modern Warplanes, by Squadron Leader H. H. Booth; Garden City Publishing Company, Inc., Garden City, New York, 1942; 25 pages, $1.00.

Power Transmission Devices

In offering a book that probably is unique in that it deals entirely with transmissions or torque converters for use with combustion engines, the author has attempted to fulfill the need for a collective source of information on the subject. The past ten or fifteen years have seen important advancements in the design of transmissions, and development has been pushed in many different directions. The book deals with torque converters for use with combustion engines in road and rail vehicles, tractors and locomotives. In introducing the subject, the author discusses terminology and general principles of torque conversion. Information then is furnished on friction, automatic clutches, and hydraulic couplings. Sliding-gear and constant-mesh transmissions and the bearing loads in these types are discussed, as are planetary transmissions and the electric drive. Other chapters deal with hydrostatic, hydrokinetic, differential, inertia-type, variable-throw, automatic, and pneumatic transmission. Many drawings and charts accompany the text.

Torque Converters or Transmissions, by P. M. Heldt; P. M. Heldt, Nyack, New York, 1942; 406 pages, $4.00.

Present Practice in Aircraft Construction

The vice-president and chief engineer of Beech Aircraft Corporation has prepared a manual of modern practice in aircraft construction for aircraft designers, production engineers, purchasing agents, and others, as well as those engaged in various courses in aircraft materials and programs in engineering, scientific, and management training for the war effort.

The purpose of the manual is to enable men experienced in aircraft work to broaden their knowledge and to assist men without experience to acquire knowledge of the materials and processes that enter into the making of a complete airplane. The book offers a detailed discussion of the characteristics, advantages, and disadvantages of important materials and manufacturing methods used in the aircraft industry at present.

Part 1 covers aircraft materials, including alloys of aluminum and magnesium and other nonferrous metals, steel, wood, and standard parts and finishes. Part 2 covers such aircraft manufacturing processes as welding, riveting, cutting, forming, machining, cleaning and corrosion-proofing and heat-treatment of metals, as well as machining and gluing of wood. At the end of each chapter blank pages have been provided so that the reader can enter notes resulting from his own experience.

Wells' Manual of Aircraft Materials and Manufacturing Processes, by T. A. Wells; Harper & Brothers, New York, 1942; 212 pages, $3.50.

Supercharger Development

A concise description of the development of the aircraft-engine supercharger is presented by an engineer who has played a leading part in the advancement of this device for increasing the efficiency of aviation engines. While much of the text originally was published in *Aviation*, the material has been considerably revised and extended. Being intended for the general reader, mathematics has been largely avoided, yet the writer presents a clear engineering picture of supercharger development and design details and outlines in a simple way the physical principles of operation, including some that until recently have not been well understood even by engineers.

The general historic background of the modern supercharger is discussed in a way that leads the reader to an understanding of reasons for certain design features incorporated in present types. Developments underlying the supercharger are discussed, consideration being given to gas turbines; nozzles and diffusers; supercharger speed; and centrifugal compressors. The arrangements of geared superchargers and turbosuperchargers are set forth and the turbosupercharger cycle is described with the aid of a diagram. In a later chapter detailed information is furnished on a typical turbosupercharger installation with particular attention to the mechanism of regulation developed after much research.

Other subjects dealt with are exhaust-intake overlap, synchronous vibration of impeller blades, intake ram, and positive displacement superchargers. In final chapters the author gives further information on the theory of supercharging and discusses the supercharger in war. The book contains many photographs and charts and also a reference list of articles dealing with the mathematics of supercharging.

Superchargers for Aviation, by Sanford A. Moss; National Aeronautics Council, Inc., New York, 1942; 103 pages, $1.00.

USEFUL CORROSION DATA*

Comparative data assumes new importance in selection of substitute materials

For many applications requiring corrosion-resistant materials, strategic alloys are no longer available. Users must therefore resort to the less restricted metals.

In this situation, the Technical Service Division of International Nickel, welcomes the opportunity to be of service.

Even though your problem may not be concerned with Nickel or its alloys, you are invited to utilize information in INCO corrosion data files.

Much of this information has been gathered by INCO Development and Research men as a result of corrosion tests carried out in various plants under actual operating conditions. It applies not only to Nickel Alloys and other corrosion-resisting materials, but also to other metals, including ordinary iron and steel.

In order to supply you with specific data on your particular problem we should know the exact conditions and circumstances involved in each case.

***A "CORROSION DATA WORKSHEET"** has been recently prepared to simplify the job. If you will request the worksheet, fill it out and return, we will gladly interpret corrosion data with respect to your individual problem. You incur no obligation. For information and assistance please address the Technical Service Division.

The International Nickel Company, Inc.

67 Wall Street, New York, N. Y.

Aerial Teamwork

The author of *The Grapes of Wrath* wrote the story of a bomber team at the request of the Army Air Forces. He made first-hand observations by visiting flying fields accompanied by a photographer whose excellent pictures illustrate the book.

The author emphasizes the roles of the bombardier, aerial gunner, radio man, navigator, and the engineer by describing how they team up with the pilot to accomplish air combat missions. To add human interest, each member of the imaginary crew is followed through his early life and training period. Their progress is given in personal terms for the enjoyment of civilian readers as well as for prospective Air Forces candidates. The royalties from the sale of the book as well as the proceeds from the motion picture, already sold for $250,000, go to the Air Forces Aid Society Trust Fund, which is perpetual (Army and Navy relief ends six months after the war)

Bombs Away, by John Steinbeck; The Viking Press, New York, 1942; 185 pages, $2.50.

Book Notes

Aircraft Spotter, by Lester Ott; Harcourt, Brace and Company, New York, 1943; 64 pages, $1.00.

The 1943 edition of this book on identification of aircraft covers modern military planes in active service of the American, British, German, Italian, Japanese, and Russian nations. It presents in uniform style photographs, drawings, silhouettes, and descriptions of current models of fighters, bombers, transports, trainers and other airplane types, together with information on their dimensions and identification points. In many cases, data are also given on the type, make and power of the engine used.

Introductory pages contain instructions for aircraft identification and sketches of the outlines of wings, fuselages, and empennages. An index is included of all airplanes covered in the book, and several pages at the end are given to quiz pictures by which the reader can test his ability in airplane identification. The answers to these questions appear on another page.

The Welding Journal Year Book; American Welding Society, New York, 1942; 136 pages.

The 1942 Year Book of the American Welding Society contains a complete roster of the members of the Society arranged in two sections, the first alphabetically and the second geographically. Information relating to the general activities of the Society is included.

Features are the secretary's annual report, a membership report, a report of the Committee on Outline of Work, and the financial report. The activities of the Welding Research Committee are covered in a supplement which consists of 20 pages.

Engineering Drawing, by Leon Marr Sahag; The Ronald Press Company, New York, 1942; 394 pages, $2.75.

This book offers a basic course in engineering drawing, characterized by conformation with the standards and procedures of industrial practice. Descriptions are brief and nonessential expositions are eliminated, but theory is demonstrated by a liberal amount of illustrations and practical problems. For purposes of study the text is divided into three parts: elementary, intermediate, and advance engineering drawing.

A Manual of Mathematics for Prospective Air Corps Cadets, by C. V. Newsom and Harold D. Larsen; The University of New Mexico Press, Albuquerque, N.M., 1942; 104 pages, $1.55.

A mathematical supplement dealing with problems of particular interest to aviation students. The mathematics covered is that of high-school level, with its interpretations directed to aeronautical applications. In addition to one reviewing arithmetic, there are chapters on proportion and variation, elementary operations in algebra, equations and formulas, graphs, and scales. Other chapters treat dimensional relations and units of measure, angular measure, vectors and vector diagrams, and the avigation computer. The Student Avigation Computer, furnished with the book, is a cardboard folder containing a concentrically mounted circular slide rule and instructions for its use.

Aerial Navigation, by Thoborn C. Lyon; National Aeronautics Council, Inc., New York, 1942; 92 pages, $1.50.

Both the elementary principles of aerial navigation and advanced practice are presented by a cartographic engineer of the United States Coast and Geodetic Survey. In opening, the author draws a comparison between the evolution of navigation at sea and in the air. He points out the similarity between the two but explains that with aerial navigation the greater speed of the airplane combined with advanced technical development has resulted in compressing the evolution of centuries into a few years. After setting forth the general principles of navigation, the writer furnishes information on piloting, the triangle of velocities, chart reading, and celestial navigation. In addition to a map, the book contains many charts and tables of value to the student of navigation and also a few illustrations.

Your Wings, by Assen Jordanoff; Funk & Wagnalls Company, New York, 1942; 294 pages, $3.00.

Ninth edition of a popular aviation primer. Written simply and interestingly, it provides a course in flying instruction from ground training and the first solo flight to navigating the overcast. A profuse amount of informative drawings helps to clarify explanations. This edition contains more advanced material than its predecessors, including an elaboration upon the subject of aerodynamics.

Flight Crew Training Program; Airlines War Training Institute, Washington, D.C., 1942; 23 pages.

This booklet outlines the Airlines War Training Institute's courses for navigators, radio operators, and flight engineers. These are divided into two groups: the fundamental course, which can be given by a school operating away from the air line; and those courses that should be given at an air-line training base. Supplementary to the description of each course, there are notes on shop courses, reference books, and suggestions for teaching.

Fire Protection; British Information Services, New York, 1942; 90 pages, $0.25.

One of an air-raid precaution series, this handbook contains advice for the protection of factories and other business premises against the hazards of fire. The two aspects of fire protection —fire prevention and fire fighting—are covered. Structural planning in relation to fire risks, general precautionary measures, methods of combating fire, and fire-fighting appliances are among the subjects studied.

Industrial Inspection and Assembly, by Edward N. Whittington; McGraw-Hill Book Company, Inc., New York, 1942; 202 pages, $1.75.

Modern methods and procedures of factory inspection and assembly are studied in this text. The information is presented progressively, with the simpler processes at the beginning, the more difficult at the end, and logical transition from one type of instruction to another. Among the topics covered are general factory procedures, use of common hand tools, simple mathematics, blueprint reading, lathe operation, precision instruments, and cutting tools.

Trophy

TO A GREAT TEAM

During 1942 the Airlines of the United States teamed up with the U.S. Army Transport Command to build, almost overnight, a global air service. This brilliant achievement has been recognized in the 1942 award of the Collier Trophy "for the greatest contribution to the advancement of aviation".

Congratulations to the Army-Airline team.

We are proud that all these transports fly with Hamilton Standard propellers.

CITATION

For pioneering world-wide air transportation vital to immediate defense and ultimate victory.

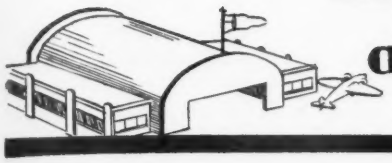
HAMILTON STANDARD PROPELLERS

ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

East Hartford, Connecticut

All American	Colonial	Inland	Pan American
American	Continental	Mid-Continent	Penn-Central
American Export	Delta	National	TWA
Braniff	Eastern	Northeast	United
Chicago & Southern	Hawaiian	Northwest	Western

House Organs and Catalogues



More on Avigation

Practical Aeronautical Celestial Navigation. Capt. James E. Farris. In this second article of a series on aeronautical celestial navigation the writer continues a preliminary historic outline of the subject. He explains the way the Egyptians used the Pyramids as triangulation points, how obelisks were used, and the Egyptian method of computing the Earth's circumference. *The Air Line Pilot*, October.

Plywood Handbooks

The Handbook of Industrial Uses for Douglas Fir Plywood has been brought out by the Douglas Fir Plywood Association, Tacoma, Wash. It is in loose-leaf form and describes industrial applications of plywood. Douglas fir plywood weight and conversion tables are furnished and a list of war uses for this material is included.

The association has also issued another loose-leaf folder containing information indicated by its title, *Technical Data on Douglas Fir Plywood.* This has been prepared to meet the war-accelerated demand for additional basic data on the subject. The information is presented with the aid of charts, tables and illustrations.

The Army Air Corps Grows Up

The Life and Times of Army Aviation. The growth of aviation within the United States Army is surveyed from the purchase of the first Army plane in 1908 to military aviation's present position of paramount importance. The development of the equipment itself, the increase in numbers of airplanes and personnel, the monies appropriated and spent on the Army's air division at different times, the contributions of industry, the periods of expansion and those of comparative lull . . . . are all recorded. Quoted figures show the size of the Air Corps at various periods of American history—before World War I, after it, in 1938, 1942, etc. Mention is made of several pioneer military flyers who today are leaders in Army aviation. Flight records set by Army aviators are also noted. *Trade Winds*, December.

Plywood Cargo Transport

Curtiss Caravans. This description of the Curtiss Caravan is supplemented by some details of its manufacture. A cargo transport of molded plywood construction, the Caravan is called a low-stall speed "workhorse," designed for 600- to 700-mile runs with short stops. Its characteristics are claimed to include low-landing speed, excellent take-off, moderate range and cruising speed, roomy fuselage, maneuverability, ruggedness, rapid-loading facilities, and economical operation. While plastic and metal materials are used in the construction of the Caravan, the airplane is made almost exclusively of wood-molded plywood, laminates, and plain lumber. *Curtiss Fly Leaf*, September-October.

Combat Performances

United Aircraft Equipment at War. A few major actions during the past year in which United Aircraft equipment played a part are reviewed. They record combat performances of the Grumman Wildcat, Consolidated Liberator and Catalina, Martin B-26, Douglas Devastator and Dauntless, Douglas Boston, Lockheed Hudson, Boeing Flying Fortress, North American B-25, and Vought-Sikorsky Kingfisher. *The Beehive*, November.

Visit to British Plants

British Air Production as an American Sees It. From his observations as a member of an American commission of aviation manufacturers to Britain, J. Carlton Ward, Jr., president of Fairchild Engine & Airplane Corporation, comments on the following: Britain's general production methods, the attitude of the people working in her factories and the amount of their output, utilization of all available personnel and space for manufacturing purposes, and underground factories. Among other things Mr. Ward reports on are: food that is obtainable in Britain, British hospitality to American soldiers, and the performance of the Fairchild C-61 with the A.T.A. *The Pegasus*, January.

Production-Degreasing

A 40-page revised manual providing data on production-degreasing and maintenance-cleaning materials, methods, and techniques has been published by Oakite Products, Inc., New York. It describes recent developments in stepping up output and increasing efficiency in the handling of over 43 production and maintenance operations.

Information is given on the application of tank immersion, washing machine, acidic, solvent, steam-detergent, and pressure-spray methods for various degreasing and cleaning operations. Among those operations discussed are the preparing of aluminum-alloy parts before resistance spot welding; degreasing ferrous and nonferrous metals before fabricating operations; rust-proofing parts between operations; cleaning aluminum, magnesium and their alloys before anodizing or other protective chemical surface treatment; and degreasing work preparatory to electroplating, painting and black finishing.

Aircraft Tool Catalogue

Aircraft tools offered by the Production Engineering Company, Los Angeles, Calif., are described in a catalogue containing 28 pages. Information is furnished on toggle clamps, drill jig bushings, scribe line duplicators, dimpling sets, riveting sets, speed drivers, duplicating punches, the drill guide pressure foot, and others. Dimensions are presented with the aid of drawings.

Gluing of Wood

Assembly Time in the Gluing Operation. L. W. Eilertsen. Consideration is given to glued-wood construction with particular reference to the time required to assemble the members to be glued and apply bonding pressure. Variable factors that influence the assembly time are enumerated. These are the moisture content of the wood, the water content of the glue, the temperature, the porous structure of the wood, the amount of bonding pressure, and the amount of glue spread. Details of the subject are discussed under sections covering contact time, wood structure, hardwoods, laminated beams, and pressure times. *Construction Glues*, November-December.

Thermocouple Construction

An explanation of thermocouple construction and assembly, designed to aid pyrometric instrument users in selection

of proper types, is carried in a current issue of the house magazine of Wheelco Instruments Company, Chicago, Ill. Discussed and illustrated are thermocouple insulators, connector blocks, heads, protecting tubes, bushings and flanges, lead wire, and lead-wire connectors. *Wheelco Comments*, Vol. 2, No. 3.

Helldivers

14 Years of Pioneering and Developing Dive Bombers. With the features of each successive plane noted, the development of Curtiss dive bombers is traced. The initial bomber described is the Curtiss XF8C-2, first of the Helldiver series—built for the Navy in 1928. The series is then followed through to the latest Helldiver, the SB2C-1. *Curtiss Fly Leaf*, September-October.

Aircraft Engineering
FOUNDED 1929

The Technical and Scientific Aeronautical Monthly

Edited by
Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 50 cents post free

Subscription: $5.25 per annum, post free

During the War, a special feature is being made of reproductions and translations from the Foreign Technical Press

BUNHILL PUBLICATIONS LIMITED
12 Bloomsbury Square
London : : W.C.1.
England

Engine Baffles

Deflector Department Moves into South Avenue Plant. In addition to announcing the removal of United Aircraft's Deflector Department to a new location, this article presents some data about the plant where they will be manufactured. It describes the conveyor system that is one of the features of the plant. An explanation is also offered on the purpose of functions of deflectors. *The Beehive*, November.

Service Overhaul

Engine Overhaul—by the Acre. A step-by-step account of the procedure in a typical major overhaul of a Cyclone engine at an Army depot. The article indicates the service facilities involved from the time the engine is flown from its home base until its return a few days later. *Trade Winds*, December.

Cellulose Plastics

A 64-page catalogue titled *Cellulose Plastics in War & Industry* has been issued by the Celanese Celluloid Corporation, New York. The manual presents specifications, properties, and applications of sheets, rods, tubes, films, molding materials, plasticizers, cements, dopes, and glazing materials. Many charts, tables and illustrations augment the text.

Flexible Shafts

Flexible shafts for remote controls are described in a 28-page catalogue issued by the Industrial Division of the S. S. White Dental Manufacturing Company, New York. Known as *Engineering Bulletin 38-40*, the publication contains data and information on various applications of flexible shafts for remote-control purposes. Charts, illustrations and tables of dimensions are included in the bulletin.

Group Riveting

Gangin' Up on Fuselage Rivets. A new method of riveting developed by the Curtiss-Wright Corporation is explained. Replacing the old system that required a separate operation for each rivet, this method employs a "gang riveter" that drives as many as nine rivets in one operation. Instead of holding up a fuselage fixture on the assembly lines until the skin has been applied, the thin aluminum covering now is assembled on a bench. The new riveting method is said to result in a 70 per cent reduction of man-hours and a 95 per cent elimination of rivet reworking caused by incorrect installation of rivets. *Curtiss Fly Leaf*, September-October.

Catalogue on Chucks

Bulletin D, issued by the Erickson Steel Company, Cleveland, O., describes Erickson chucks for drill presses, lathes, milling machines, screw machines and portable electric air drills. The principle of the eight-point collect grip feature of these chucks is outlined with the aid of drawings.

Maintenance Manuals

Titled *Service and Maintenance Manual for Pesco Standard Gear Type Hydraulic Pumps*, book No. H-132 is intended to be a general guide for installing and servicing Pesco engine-driven gear-type pumps. The first section of the handbook contains an explanation of the design features of gear pumps. Instructions for installation, inspection, maintenance, overhaul, reassembly, and final test appear in succeeding sections. Since installation problems vary with different types of airplanes, the instructions for installation are necessarily of a general nature and are clarified by diagrams and cutaway drawings. General procedures for service inspection, maintenance, and overhaul are suggested in connection with the usual inspection periods, along with information on lubrication. Test procedures are also specified as a check for satisfactory performance after a pump has been overhauled. The final section is devoted to a discussion of the causes and correction of difficulties.

Another book, No. F-105 B, is titled *Pesco Fuel Pump Handbook*. It contains an explanation of the Pesco fuel pump design features and principles of operation, followed by detailed instructions for installation, lubrication, inspection, maintenance, overhaul, and final test. Illustrations consist of sectional and cutaway drawings and circuit diagrams. *Pump Engineering and Service Corporation Division, Borg-Warner Corporation*, Cleveland, O.

New Square D Catalogue

The Square D Company has issued a new edition of its catalogue entitled *Air-Line*, carrying detailed descriptive and engineering information on its products, which include circuit breakers, switches, relays, contactors, push buttons, limit switches, and special-purpose devices, designed primarily for aircraft and tank use.

Engine Maintenance Training

Cyclone Schooling for Soldiers. The physical and educational aspects of the Wright Aeronautical Corporation's Technical Training School for Army Air Forces personnel are outlined. At this school selected men from the Army Air Corps spend 18 days learning to become specialists in the servicing of Cyclone engines. Each student is trained to be an expert not on Cyclones generally but on a particular type of Cyclone, some on single-row engines, others on double-row engines, etc. As described, the Wright school is com-

plete with barracks, mess and study halls, classrooms, and a battery of test cells. *Trade Winds*, December.

Alemite Catalogues

The Alemite Division of Stewart Warner Corporation announces two new brochures, a leaflet describing the Alemite "Lubrikart" and a 50-page catalogue of Alemite industrial lubrication equipment.

A feature of the catalogue is a selection guide provided for convenience in determining the lubricating equipment best adapted to lubrication requirements. The equipment is charted in accordance with the kind of lubricants pumped (fibrous, heavy, or light bodies), container capacity, operating power (air or electric), and pressure (high or low). Described in the catalogue are stationary and portable power guns, lubricant loaders and transfer pumps, and all types of manually operated greasing equipment.

The portable Alemite "Lubrikart" is designed to reduce maintenance time to a minimum, bringing a complete power lubrication department to any machine in the plant. These units, mounted on hand trucks, may be easily maneuvered throughout industrial plants.

Capacitor Applications

A pamphlet telling how industrial plants can increase the capacity of their power systems by the use of capacitors is offered by the General Electric Company. The names of some manufacturers who have increased the load on their systems by the installation of capacitors are furnished. With the aid of a diagram, an explanation is given of how capacitors are used to increase the load of plants provided with inductive equipment. Information is presented on the installation of capacitors.

Aero Material Specifications

The Society of Automotive Engineers has issued, as of December 1, 1942, additional new and revised aeronautical material specifications. Forty-three new specifications and 33 revised specifications are included.

Assembly Templates

Detail Assembly Templates Speed-up Production. R. V. Keys. Data are presented on the uses to which the Lockheed and Vega aircraft companies apply detail assembly templates. By means of these templates, full-size outlines of parts are obtained. They are reproduced by one of two methods: photographically or by the Prest process, which consists of plating the desired outlines onto the part or template stock. In addition to specifying how almost all of the templates, jigs, and fixtures required to build an airplane can be fabricated from a detail assembly template, the article tells how contoured parts are made from this type of template. *Lockheed Vega Aircraftsman*, December.

NE Steel Booklet

A new booklet on National Emergency steels has just been published by Joseph T. Ryerson & Son, Inc. This simplified data book deals with the selection and heat-treating of NE steels.

The Jominy end quench hardenability test, a quick method of determining the heat-treatment response, is explained step by step, and a cutaway diagram shows the test in action. It is explained that the Technical Committee of the American Iron & Steel Institute has adopted the Jominy test as the standard for testing NE steels.

The booklet includes four tables for converting Jominy test results into tensile strength, yield point, elongation, reduction of area, etc. One table indicates the cooling rate at various distances from the quenched end of a Jominy test sample. Another table gives the cooling rates at center, half radius, and surface for 1, 2, and 3 in. round bars quenched in oil and water. A third table shows the approximate relationship of physical properties to hardenability. The last table gives the approximate relationship between drawing temperatures and tensile strength.

The various NE steels are listed as suggested alternates for standard compositions in the carburizing, medium-hardening, and high-hardening groups. The booklet also shows average physical properties after heat-treating, together with forging, normalizing, annealing and quenching temperatures for 30 of the most widely used NE steels. Available stock sizes in the various NE analyses, both hot- and cold-rolled, are also given.

Press Plates

"Cookie Cutters." How press plates operate, their construction, uses, and advantages are related in this article. Employed in the production of Flying Fortresses, the press plates described are used in fabrication presses for cutting metal patterns from sheet aluminum. *Boeing News*, December.

Ranger Engines

Inline Aircooled Engines at War. Supplementary to a discussion of the features and advantages of Ranger inline air-cooled aircraft engines, brief descriptions are given of the plants where they are built and some of the more unusual production methods employed for their manufacture. It is stated that, combining the most desirable features of both liquid-cooled and radial engines, Ranger products eliminate the cooling mechanisms and connections of the liquid-cooled type and yet have low frontal area and excellent streamlining characteristics. Although certain cooling difficulties in the early development of this engine are admitted, it is claimed that these are no longer considered limitations. Charts are shown to illustrate the plant expansion, growth of production, and increase of personnel in the manufacture of Ranger engines since 1939. *The Pegasus*, January.

Atmosphere

Health Topics. Col. A. D. Tuttle. First part of a discussion dealing with the effects of altitude on men and machines. This installment defines and reviews the physical and chemical nature of the atmosphere. It refers not only to the properties of the explored layers of the atmosphere—the tropopause and stratosphere—but to that of other layers that are of scientific interest. *United Air Lines News*, December.

Tooling for Production

An Airplane Is Born. Palmer Wentworth. Fifth part of a series detailing the construction of an airplane from the drafting board to its completion. This installment deals with the first step in the actual production of the plane—tooling. It indicates briefly the specifications that the design and buildings of fabrication tools and equipment must meet. It also explains the functions of jigs and fixtures. At the Ryan Aeronautical Company, with which the article is specifically concerned, tooling activities are divided among three departments: tool planning, where the type of tooling is decided; tool design, in which tools and equipment are designed; tooling, in which the same tools and equipment are built. *Ryan Flying Reporter*, December 11.

Heat-Treatment of Alloys

Tips on the Heat Treatment of Aluminum Alloy Products. G. B. Berlien. Consideration is given to the heat-treating aspects of such aluminum alloys as are heat-treatable. The writer discusses temperature control, warpage correction, the elapsed time in transferring from the solution heat to the quench, corrosion resistance and the use of the blower-type fog quench. *Heat Treating Hints*, Vol. IV, No. 8.

Aircraft Roller-Chain Handbook

The Diamond Chain and Manufacturing Company, Indianapolis, Ind., has just published *Engineering Handbook No. 643*, giving complete information on the selection, installation, and

Essential in fusing today's aircraft

LITTELFUSES

Tested by Magnetic Vibrator, far in excess of most extreme conditions

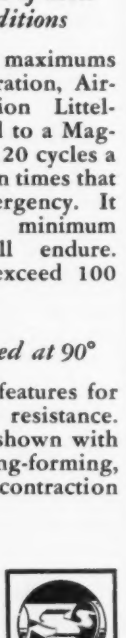
Providing for new maximums of shock and vibration, Aircraft Anti-Vibration Littelfuses are subjected to a Magnetic Vibrator at 120 cycles a second. Test is ten times that of any service emergency. It determines the minimum hours fuses will endure. Littelfuses often exceed 100 hours of this test.

Elements twisted at 90°

One of Littelfuse features for severe vibration resistance. Twisted element shown with "Gooseneck" spring-forming, which takes up contraction and expansion.

Locked Cap Assembly

An important Littelfuse anti-vibration factor. Caps are locked. No cement used. To vibration-prevention it adds saving the caps with markings. Also seals element against climatic conditions.



LITTELFUSE INC.

4737 Ravenswood Ave.,
CHICAGO, ILLINOIS

maintenance of precision roller-type chains and sprockets for aircraft usage.

The principles that should govern the selection and specification of chains and sprockets for aircraft and aircraft armament are outlined. Complete data are given on a range of chains that experience has shown to be particularly suited for aircraft service.

The handbook is intended for those who are concerned with the design, specifications, procurement, inspection, installation, and maintenance of chains for aircraft.

Metal Removal in Industry

A booklet presenting a story in pictures of how the Doall contour machine for band sawing, band filling, and polishing is speeding production in the nation's war effort. One hundred and fifteen photographs illustrate precision methods of removing metal. Sections cover mass production, three-dimensional production, "short-run" stampings, special fixures for handling production jobs, continuous filing operations on production jobs, special work, contour sawing, and attachments for greater versatility. *Continental Machines, Inc.*, Minneapolis, Minn.

Aeronautical Navigation

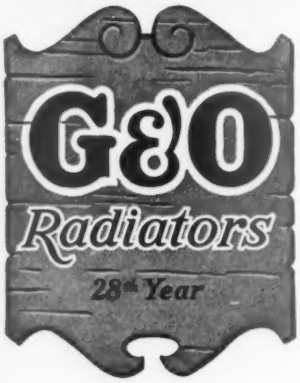
Practical Aeronautical Celestial Navigation. Capt. James E. Farris. This is the third in a series of articles on aeronautical navigation. The writer continues a historic outline of the subject. He then defines declination and tells how it is interpreted. *Air Line Pilot*, November.

Structural Testing

Break Men. The work of the structural test unit of Boeing's engineering division is outlined. The purposes of various tests for which it is responsible are noted. Among the tests alluded to are: wing, endurance, vibration, wear and pressure tests. *Boeing News*, December.

Airscrew Design

Propeller Development. K. B. Gilmore. A study of the progression of propeller design from the first flight made by the Wright brothers to the developments prompted by the present war. Improved performance resulting from the introduction of constant-speed and variable-pitch propellers is examined in detail. Comparison is made between hydraulically and electrically operated propellers, while the use of each type by the United States, Great Britain, France, and Germany is noted. Touching upon their main advantages and disadvantages, materials for propeller blades are discussed. Solid duralumin is selected as the most popular material, but others also de-



ENGINE COOLING RADIATORS

•

OIL COOLERS

•

The G&O Manufacturing Co.
NEW HAVEN, CONNECTICUT

STURTEVANT
QUALITY
Permanently Accurate
Torque Wrenches
A Complete Line
of permanently accurate measuring and gauging wrenches that are standard in leading war plants for gauging and controlling torque in production and for testing and measuring in inspection. Indestructible taper beam construction. Double scale visible from all working angles. Capacities from 0 to 7200 inch pounds.
Write for Bulletin
NO
Friction
Adjustments
Moving Parts
Fragile
Mechanisms
P.A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

scribed are hollow steel, compressed wood, and magnesium.

After reviewing the development of feathering and multiblade propellers, future trends are indicated. It is predicted that eight- or ten-bladed counter-rotating pairs of propellers will be used. The probability of employing the propeller as a brake is remarked also. *The Intava World*, October.

Tool Production

Production operations that are aiding the war effort, as carried out at the plant of the Spriesch Tool & Manufacturing Company, Buffalo, N.Y., are portrayed in a 36-page brochure titled *Ingenuity*. The booklet reveals the company's facilities for the production of many types of tools and equipment.

Mission to Britain

Report on England . . . After a two weeks' survey of English airplane factories, a United Aircraft executive reports some of his impressions. His brief comments touch upon British morale, underground factories, labor-shift schedules, and factory personnel. He also mentions the food, automobile, and weather situations in England. The use of Hamilton-Standard propellers on British, as well as American, planes in Europe is also noted. *The Beehive*, November.

Electric Drill Handbook

A new handbook recently published by The Black & Decker Manufacturing Company, Towson, Md., is designed to show new workers the correct methods of using portable electric drills and obtaining greatest efficiency and longest life from these war-production tools.

The booklet covers such points as assembling the drill, the switch control, drill chucks and bits, how to use the drill, and several important points on user maintenance and care. The booklet is being packed with all Black & Decker drills shipped from the factory and is offered to electric drill users through Black & Decker's distributors and field engineers.

Booklet on Joint Gluing

A nontechnical booklet on gluing procedure, titled *The Casco Trouble-Shooter for Joint-Gluing*, has been brought out by the Casein Company of America, New York. Designed particularly as an aid to glue foremen and inspectors, the booklet contains sections covering weak bond wood conditions, machining, the preparation and handling of glue, pressure, low water-resistance warping, and stain.

Bomber Wing Test

"Test to Destruction." Roland Bradley. The step-by-step procedure of wing testing at the Boeing Aircraft Company is traced. A report is made on how tremendous pressures are brought to bear on wing surfaces to discover at exactly what point the wing will buckle and break. Loading is past the 100 per cent point set by design specifications. *Boeing News*, December.

Little-Known Facts

The fourth edition is presented of a pamphlet titled *Little Known Facts About the Scheduled Air Transport Industry*, emphasizing the contribution to the war effort made by domestic and international air lines of the United States by means of charts. *Air Transport Association of America*, Washington, D.C.

Air Transport Command

Air Transport . . . . Unlimited. The creation of the American Air Transport Command, its rapid growth, and its achievements are described. Indicating the far-flung scope of the Command's activities and the importance of its functions, the article credits the men in charge of it—Major Gen. Harold L. George and the air-line executives who have joined the Army to aid him in facilitating the transportation of supplies and equipment to all the Allied fronts. Account is given of the Air Transport Command's personnel, the variety of planes they fly, and the speed with which they travel. *Trade Winds*, December.

Press Operations

Pressing for Production. This article tells how the Bell Aircraft Corporation's Press Division of Metal Fabrication carries on its work. Details are given on the machines used for the various procedures and the men in charge of the department are named. The department consists of the three main divisions: Hydraulic Presses, Crank Presses, and Forming Brakes. Corollary activities include shaping on the Farnham Roller, making hinge strips on a Draw Bench Roller, Sawing and Drilling, and Bench Work Finishing. *The Bellringer*, December.

Gyro Horizon Production

A Bee Can't Fly . . . But it Does. Under a title based on the amusing story to the effect that a bee cannot fly, the writer tells how the General Motors Ternstedt Manufacturing Division is in production three months ahead of schedule on the Sperry gyro horizon. It is explained that the manufacture of these instruments requires precision machining at extremely close tolerances, perfect polishing of small moving parts, and the utmost cleanliness in all mechanism. The writer states that this is the first time work of this nature has been carried out by an automotive manufacturer. *GM Folks*, December.

Future Air Transport

The Future of Air Transportation. The executives of American Airlines present their views of air transport's future. How the demands of war are accelerating the development of transport planes is described. It is predicted that after the war transports will be built to carry more than 100 persons and tons of cargo. A comparison is drawn between the time necessary to transport by air and by rail. Factors that will determine the postwar volume of air cargo are discussed. *The Exchangite*, September.

Handbook on Plastics

Lucite Aircraft Manual. This loose-leaf manual contains recent information on the forming, fabrication, and physical properties of transparent sections of airplanes and airplane enclosures from "Lucite" methyl methacrylate resin. Methods of fabricating the material are described in detail for aircraft applications as well as other products and uses. Information is given on the care and handling of the material, sawing, blanking, punching, drilling, tapping, sanding, scraping, finishing, cleaning, cementing, forming, installing, and repairing "Lucite." Together with pictures and diagrams illustrating these operations, the manual lists the mechanical, thermal, optical, electrical, and general properties of the plastic.

Copies of the manual are available to executives, business men, and engineers upon request on business letterhead, from the Plastics Department of the E. I. du Pont de Nemours & Company, Inc., Arlington, N.J. Supplementary information on this subject will be prepared and sent to holders of the manual from time to time for insertion in the book.

Photo Tracing

Foto Facts. Don Merry. This is the first of a series of articles on the photographic departments of Lockheed and Vega. It describes a new process that they have evolved known as "photo tracing." This process produces a blueprint that carries a photographic image of the part instead of a drawing. In addition to the photographic reproduction possessing the advantage of engineering callouts, it is said to result in a saving of man-hours amounting to 75 per cent. The article gives the list of Lockheed-Vega employees who work in this department and tells what each one does. *Lockheed-Vega Aircraftsman*, November.

With Their Help We'll Win

These women, machining precision parts on South Bend Lathes in a vital war plant, are typical of thousands of women who are doing their part to win the battle of production.

With eager hearts and nimble fingers, thousands of American women are working shoulder to shoulder with men in vital war industries — replacing those who have left their machines to defend their country. And they are doing a fine job of filling men's shoes, for they know that the battle of production must be won to keep their men at the front supplied with the guns, planes, tanks, bullets, and thousands of other things an army must have to be victorious.

Women learn to operate South Bend Lathes in a surprisingly short time. Not that just any girl can become an expert machinist or toolmaker over night. But on certain classes of work—the kind of work you would expect a beginner to do—women are highly successful.

Quick to appreciate quality, women like South Bend Lathes. They like the fully enclosed design with no exposed pulleys, belts, or gears—the smooth operation of conveniently placed controls—the absence of rough edges and sharp corners that might catch their clothing—the dependable precision that enables them to turn out maximum production, even when extremely close tolerances are specified. And, most of all, they appreciate the ease of operation which reduces fatigue to a minimum and seemingly shortens the work-day by hours.

South Bend Engine Lathes and Toolroom Lathes are made in four sizes, 9″ to 16″ swings. South Bend Turret Lathes are available in three sizes. Write for information, specifying size and type of lathe in which you are interested.

"HOW TO RUN A LATHE"
A valuable handbook for apprentice training. Explains the operation and care of engine lathes. 128 pages—365 illustrations. Sent postpaid for a 25c War Stamp.

SOUTH BEND LATHE WORKS
SOUTH BEND, INDIANA — LATHE BUILDERS FOR 36 YEARS

From the Industry

Speedy Rivet Gun

Of comparatively recent introduction to the domestic market, but with a record of service abroad, a device called the "RD riveting gun" and a line of special rivets are claimed to have numerous advantages in speed and ease of operation. The "gun" is designed to be worked by an unskilled man or woman and to reach inaccessible places for blind riveting. The makers state that about 9,600 hollow rivets can be set in an eight-hour shift without noise or buckling of the metal plates. The machine is hand operated, requiring no electric or air power and producing no vibration. It contains a magazine feed for the rivets and mechanism for driving the rivets into place and upsetting them. The rivets are supplied in various forms and sizes in accordance with Army and Navy specifications and have properties of expansion to fill oversize holes or inaccurately drilled holes. One of the advantages claimed for this equipment is that it can be used for emergency repairs on an airplane and that it can be used, if necessary, while the plane is in flight. Airsealand Aircraft Inc., Long Island City, N.Y.

New Nut for Plywood Plane and Glider Fastenings

The increase in the use of plywood and plastics is said to have been made possible in great degree by a new type of fastener that has facilitated the work of securing plywood to metal. One such device, known as the Boots Self-Locking "Cage" Nut was designed to speed production and subassemblies in plywood aircraft.

The Boots Self-Locking "Cage" Nut incorporates the familiar wing style, all-metal, self-locking principle and may be applied, if necessary, in a "blind" application from one side by a single operator. The basket mount of this nut is "collapsed" with a special clinching tool. The collapsed mount then clinches the plywood in a claw-like grip that withstands, without tearing, the torque applied when a bolt is inserted by production methods.

Adjustable to varying thicknesses from 1/16 in. upward by the use of stop arrangements, the clinching tool effectively sets the mount into the plywood or plastic. Boots Aircraft Nut Corporation, New Canaan, Conn.

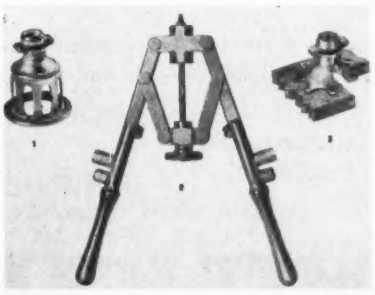
Tool Standardization

Savings are found to be inherent in a program of "tool standardization" in tool inventories, costs, reduced tool design requirements and in the time involved in securing new tools, as well as conservation of materials and the reduction of tool breakage by inexperienced workers. The problem is materially simplified as the result of the ready availability of standard stock tools, particularly from the carbide tool industry, covering the majority of machining requirements.

The application of a program of standardization in the average plant involves only a few simple steps. While there are many ways of effecting such a program, experience has shown that the following method is suitable for installation in most plants.

The first requirement is to have available a fairly complete record of what tools are being used on various jobs and operations. Where such records are not available, experience has shown that a survey of tools will save time and money when used to effect a program of tool standardization.

The next step is to analyze these operations to determine how many could be performed satisfactorily with the same tool type—regardless of whether the tool is a standard stock tool as available from carbide manufacturers or not. These tools then become "plant standards." It is stated, however, that in a large majority of cases it will be found that the sizes and styles correspond to standard stock Carboloy cemented carbide tools. It was also often found that one tool shank size and grade of carbide could be used on a great many operations and that the large majority of all turning, boring and facing operations, for instance, could be performed with a small group of tools that differ only as to shank size, grade of carbide, and basic shape of tool. These will generally take care of an average of 60 per cent of the operations involved.



The Boots Aircraft Nut Corporation's new speed nut for use in plywood plane and glider production.

Of the remaining 40 per cent, it is said to be possible to take care of as many as three out of every four by slightly altering a standard tool. For example, suppose an operation requires a 5/8-in. chamfering tool. This is easily obtained from the plant standard by grinding a standard tool to the shape required. The operation involves simply the grinding off of one corner of the tool. The same tool can be used to produce many other varieties, such as forming a fillet radius or for undercutting. Other special tool types can be obtained from other "plant standards."

It is usually desirable to adopt a standard system of markings for all tools used as or developed from "plant standards." Thus, the tool number of the "plant standard" is given a series of suffixes designating individual special shapes. The process makes possible ready identification of the particular special and the "plant standard" from which that special was obtained. Carboloy Company, Inc., Detroit, Mich.

Modern Research Laboratory and $2,100,000 Wind Tunnel

The Airplane Division of Curtiss-Wright Corporation is rushing to early completion in an eastern city what is said to be one of the largest and most fully equipped research laboratories in the nation. The "heart" of the new laboratory will be a large wind tunnel designed for testing models of future airplanes operating at simulated speeds exceeding 700 m.p.h. Now being built at a cost of $2,100,000, it is expected to be one of the largest and most advanced wind tunnels ever erected by an aircraft manufacturer. A similar tunnel, now being constructed at Pasadena, Calif., is being financed by the Consolidated, Douglas, Lockheed and North American aircraft companies.

The new eastern wind tunnel will be made available to other aircraft manufacturers through the facilities of the

Every American Bosch aviation magneto gets a grueling run-in test to check the efficiency of our "modern New England craftsmen."

Here every ounce pays its own way

WHEN a flat-top swings into the wind and her warbirds race along the runway, *nothing* goes along just for the ride . . . *every ounce* of the plane's weight must pay its own way. To help squeeze the ultimate bit of energy from each drop of gasoline is the job of American Bosch magnetos. Remarkable advances in magneto design, these units not only deliver the *right* high-tension spark at the *right* split-second of time, but also open the way to altitudes far higher than ever before.

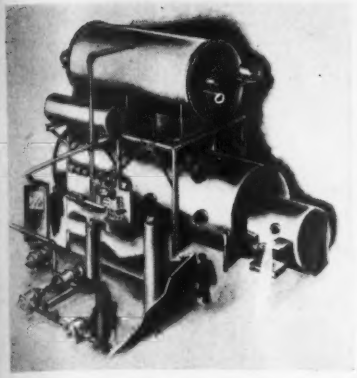
Secret of American Bosch *precision* mass production is our large staff of "modern New England craftsmen"... men and women highly skilled in *specific* jobs, turning out work to tolerances measured in millionths. This *new* New England craftsmanship has been supplied through American Bosch engineering, planning, training, and tooling. The same know-how directly serves designers, manufacturers, and users of gasoline and Diesel engines.

This "modern New England craftsmanship" is now putting on the pressure to help America win a decisive Victory. *American Bosch Corporation.*

AMERICAN BOSCH

AVIATION & AUTOMOTIVE ELECTRICAL PRODUCTS . . . FUEL INJECTION EQUIPMENT

MODERN CRAFTSMEN IN THE NEW ENGLAND TRADITION



A perspective drawing of the altitude chamber now being erected by the Airplane Division of the Curtiss-Wright Corporation as a part of its newly completed Research Laboratory at Buffalo, N.Y.

newly established Aircraft War Production Council, East Coast, Inc. This Council was recently organized to enable eight major eastern aircraft manufacturers to pool their resources so as to attain maximum aircraft production for the war effort as quickly as possible.

Other new facilities of the laboratory include means for making exhaustive altitude tests in a newly designed altitude chamber that will accommodate single-place fuselages and reproduce actual dive and climb conditions. Facilities also are planned for extensive static and structure tests.

The new research laboratory will be operated under the direction of Dr. C. C. Furnas, formerly of Yale University, and a staff of specialists in the design, structure, durability, speed, and performance of aircraft types ranging from fighters and dive bombers up to all-metal and all-wood cargo transports. These include Dr. Norton Moore, chief of aerodynamic research, who, with Dr. Clark B. Millikan of the California Institute of Technology, designed the new laboratory; Peter F. Rossmann, chief of the developments department; E. S. Jenkins, chief of materials and structures research; C. G. Trimbach, assistant chief of the developments department; and W. E. Voisinet, manager of the laboratory.

While the new laboratory will concentrate largely on problems relating to the development of aircraft for the war emergency, no limitations have been set on the fields to be explored for future developments.

New Pressure and Detonation Pickups

Electro pressure and detonation pickups are used with Diesel and gas engines, also with pumps, compressors and similar mechanisms to record instantaneous pressure and other phenomena occurring within the firing or compression chambers. The device consists of a magnetic-type pickup, having a diaphragm that is exposed to the explosion or pressure forces within the cylinder. Vibration of the diaphragm produces magnetic flux variations in a coil assembly that provides an output voltage having identical characteristics to the varying pressures developed in the cylinder.

Two types are now available, namely, models Nos. 3000 and 3000A. The model No. 3000 fits into a hole in the cylinder which is tapped to receive a $^{7}/_{8}$-in. 18 thread. The No. 3000A fits into the standard aircraft engine 18-mm. spark-plug hole. Output voltages as high as 40 millivolts are obtainable from these pickups when used with the standard C.F.R. gasoline testing engine using 70-octane rating gasoline, this voltage being total of detonation and regular explosion. Should detonation or any cyclic engine pressure voltage be required, the Electro filter model No. 2300 can be used to select these voltages over a range from 2,000 to 8,000 cycles.

The construction of this pickup eliminates binding post connections. It is only necessary to screw the socket attached to a shielded 7-ft. cable to the end of the pickup, and then a completely shielded connection is made to the pickup terminals. The complete electrical shielding of the pickup and cable eliminates ignition and other undesired electrical interference. Two types of diaphragms are furnished with each pickup: one for ordinary pressures met with in gas engines and compressors and the other for high compression aviation engines. Electro Products Laboratories, Chicago, Ill.

Special Broach for Gear Blanks

A broach designed at a General Electric plant finishes holes within two ten-thousandths of an inch of being perfectly round and straight. It is being used to finish-broach the bore in gear blanks and similar parts where the initial machining operation must be held to this tolerance to prevent magnification of error in subsequent machining. The new tool overcomes difficulties previously encountered because of broach contortions and such variables as contour of parts and material specifications.

The design of the new broach is simple. It is inexpensive to make and, because it is much shorter than the conventional broach and is used on a hand arbor press, it is said to be more economical to operate. Resharpening is easy and is necessary only after 4,000 to 5,000 parts have been finished.

The broach was designed to finish the bore with a burnishing effect to within the 0.0002-in. tolerance after it has been rough-broached 0.00005 in. under size. The broach used formerly was ground to a 0.0005 in. under size to allow 0.0005-in. stock to be removed with the finishing broach.

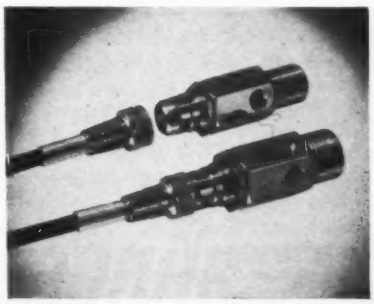
The new broach is made of high-speed steel with a pilot 1 in. long, the diameter of the rough-broached hole, a double buttress thread approximately 3 in. long, and a shank long enough to push the buttress through the work. The diameter of the shank is the same as the diameter of the finished hole. The reaming portion has a taper of 0.0004 in $2^{1}/_{2}$ in., and the last half inch is left the size of the finished hole. A good burnishing effect is obtained if the last quarter inch is not backed off as much as the cutting part of the broach.

This design can be modified readily in accordance with the hole being broached and the material of the part. The smaller the diameter of the hole, the finer the thread that will be required. For example, eight threads per inch should be used for a $^{1}/_{4}$-in. diameter hole, whereas six threads per inch should be used for a $^{1}/_{2}$-in. diameter hole. A single thread with hardly any undercut should be used for brass, while a triple thread with as much undercut as possible should be used for aluminum.

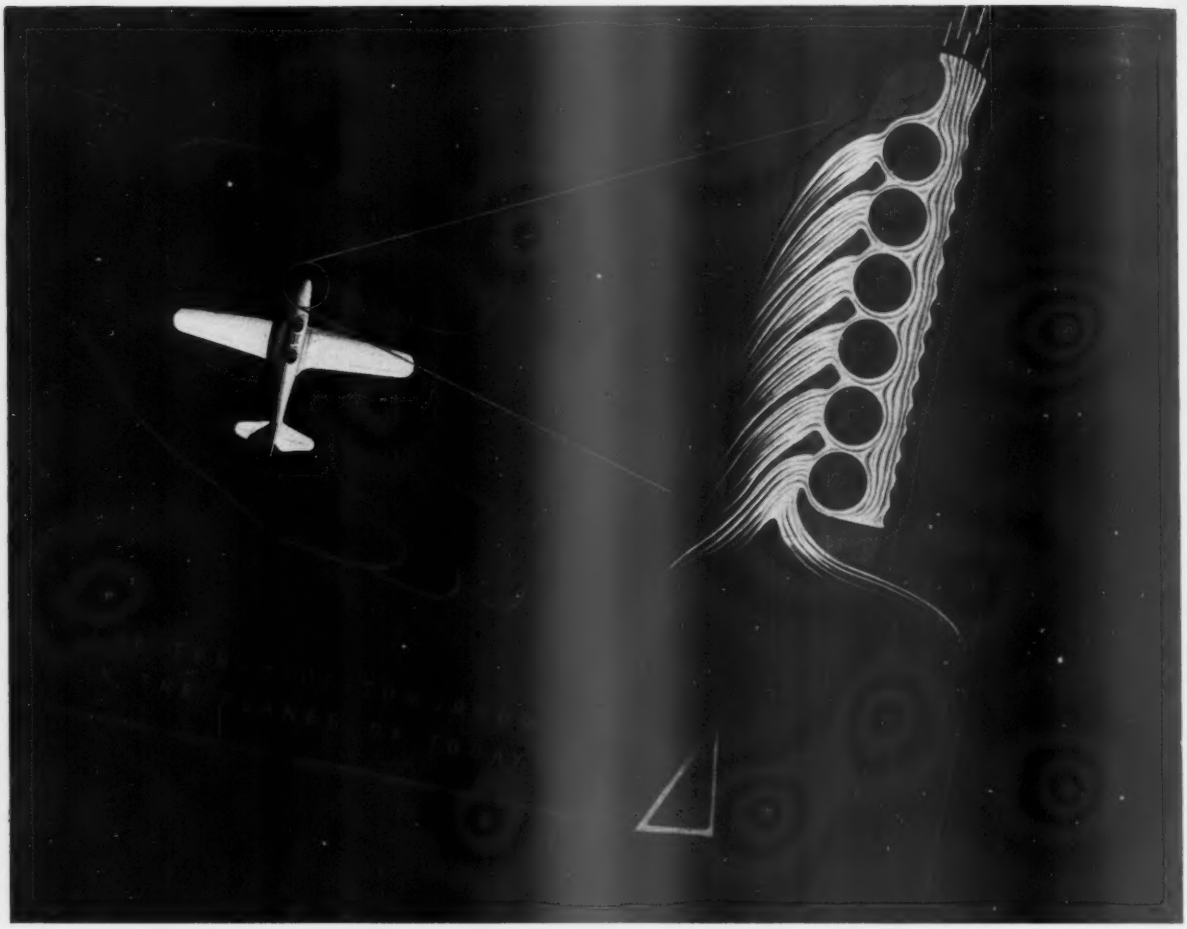
Conversion to Aircraft Production

In a brochure of 20 pages, the Eastern Aircraft Division of General Motors Corporation presents a chronologic case history of the principal steps that took place when five automotive plants were dismantled, retooled, and assigned to the production of airplanes. It gives a summary of the events involved in the reorganization of those five General Motors plants that formerly built a wide variety of automobiles, bodies, and other automotive components into a unit that was converted in less than a year to the manufacture of Grumman Wildcat fighters and Avenger torpedo bombers for the Navy.

It is recounted how the plants were dismantled, existing machinery rearranged wherever it could be used, new machinery was installed, and workers were trained in new methods of mass production. New assembly lines replaced the old ones and additional workers, including many women, were em-



Electro Products Laboratories pressure and detonation pickups.



Ranger Solves the In-Line Air Cooling Problem

A scientifically engineered air-scoop, baffle, and air pressure "reservoir" arrangement delivers uniform air pressure at each cylinder, maintaining uniform temperatures in all cylinders at all times.

When Fairchild began its researches into the air-cooled, in-line aircraft power plant, it began "from scratch." The formidable difficulty of air-cooling cylinders which were set one behind another had discouraged many. Interest had been diverted to radial air-cooled and liquid in-line design. Fairchild believed that the tremendous advantages of air-cooling combined with those of inverted, in-line arrangement were vital to this country's aeronautical progress. Fairchild spent a decade in the laboratory developing such an engine type . . . the Ranger. A simple yet amazingly efficient method of "pressure cooling" solved the primary problem. Today—the only engines of their kind in America—Ranger air-cooled, inverted, in-line engines are powering the planes of the United Nations. They are the most efficient and reliable engines in their power class. They not only justify in every respect the years spent in their development but, as with all Fairchild achievements in the science of aeronautics, they bear the unmistakable Fairchild "touch of tomorrow." Continuing researches demonstrate that they are the beginning of a new and brilliant chapter in aircraft engines and the planes which they make possible.

ON THE BEAM

"This government, the offspring of your own choice, . . . has a just claim to your confidence and your support." George Washington

RANGER AIRCRAFT ENGINES

Division of Fairchild Engine and Airplane Corporation · Farmingdale, Long Island

ployed. The completion of the first of these airplanes and its initial flight are described, and it is stated that production is continuing in large numbers.

Portable Hydraulic Airplane Lift

A portable electric-hydraulic lift, type A-70, built for raising airplanes to free landing wheels from the ground, has been announced by Globe Hoist Company, Philadelphia, Pa. This lift was developed particularly for airplane service, inspection, and maintenance operations in airports and hangars. The lift may also be used for assembly work in aircraft plants.

From a "down" position of 50 in., the lift provides a power rise of 27⅝ in., plus a hand adjustment rise of 33¾ in. or a total lifting height of 111⅜ in. The top of the plunger is equipped with a half-ball socket to make contact with the plane's wing jacking pads or can be placed underneath the tail or nose section. The extended height of the power plunger may be locked in any of various heights by inserting a steel safety bar through holes spaced 3 in. apart along the entire length. The hand adjusted screw jack portion of the plunger may also be locked at any height.

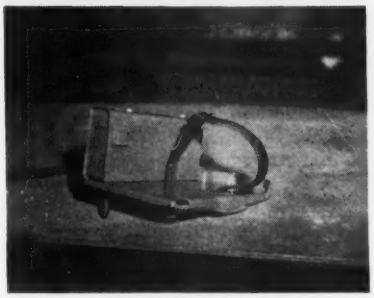
The power cylinder is operated by means of a 5-hp. electric motor, direct connected to a 15-gal.-per-min. geared pump. Oil displacement of the power cylinder is 7 gal. Maximum lifting capacity is 21,000 lbs., and the sustaining load capacity is 63,000 lbs.

The lift chassis is shaped so that it may be used close beside the airplane's landing gear and provide full clearance for the wheels.

The entire lifting mechanism—cylinder, plunger, oil reservoir tank, pumping unit and electric motor—is mounted on a base plate that is suspended independently from the chassis by three completely housed coil springs placed at each point of the V-shaped chassis frame. When not under load, this base plate is held up 2 in. from the floor and the lift may be moved about on large, antifriction type wheels. Under load, the base plate is forced downward to engage the floor, thereby providing the firm stability of a wide-area lifting base.

Chemigum in Fuel Lines

Goodyear Tire & Rubber Company's Chemigum is now being used in the rotors within fuel lines of warplanes to show the pilot how fast his fuel is being consumed. Each rotor is mounted directly in the center of a plane's major fuel line, with the center shaft parallel to the flow of the gasoline. The stainless-steel shaft of the rotor is covered at each end with a sheath of Chemigum to resist the solvent action of the gasoline, whereas natural rubber would swell and distort and possibly clog up the fuel line.



Lincoln Electric Company's arc-welding "Lincontrol."

In the center of each rotor is a bushing of magnetized metal. Propeller blades on the outside of each rotor force the roller to revolve as the flow of gasoline strikes them. Thus, the rotor revolving inside the metal fuel line acts in the same manner as an armature, generating electrical impulses which are transmitted by wires from the fuel line and the rotor's mountings to the airplane's instrument board. As the flow of fuel increases, the strength of the electrical impulses is raised, which, in turn, reflects on the calibrated dial and records the volume of fuel usage.

At present the Goodyear company is manufacturing only the rubber-covered shafts with their bushings of magnetized metal. The metal parts of the rotors are made and assembled by the Breeze Corporations, Inc., Newark, N.J., which distributes the completed rollers to the airplane makers.

"Lincontrol" Arc Welding Control

An arc-welding control unit, called the "Lincontrol," has been announced. The control is almost as light as a shoe, is strapped onto the welder's foot, and enables him to move about with it freely. While specially intended for aircraft welding, it is said to be applicable for welding of light-gauge sheet metal of all kinds. Because it is so easily used, it is expected to be especially suitable for women welders.

With the control strapped to his foot, the welding operator merely presses down on the pedal that moves the pin to operate a current control. As he exerts pressure he increases the current. This is said to permit accurate control over the welding arc and to achieve in one unit the same results as both the so-called "hot-start" and "crater eliminator." Because he has complete control, the welder can adjust the arc at any time without changing his position. While welding in and around a fuselage assembly on "pickup" work, he can move around at will without the hindrance of constantly keeping his foot in one place.

It is claimed that the control eliminates the necessity of making adjustments on the welding machine to meet such conditions as minor changes in thickness and changes in fit-up, enabling the operator to weld in any position that he finds convenient or comfortable. The control is designed for the Lincoln "Shield-Arc Junior" welders. Lincoln "Junior" welders now in the field can be adapted for the control by any shop electrician by obtaining a new voltage rheostat for the welder. Sold separately from the welding machine, the controls can be delivered in a short time. The Lincoln Electric Company, Cleveland, Ohio.

The Lockheed Constellation

Designed and built for Transcontinental & Western Air, Inc., the new Lockheed Constellation will be turned over to the Army by T.W.A. for wartime duty. At a top speed comparable with the cruising speed of fighter planes, it is claimed to be capable of flying a light tank and its complement of troops across an ocean. Said to be faster than the Japanese Zero or any four-engined bomber now in active service, the Constellation will cross the continent in less than nine hours or fly from California to Honolulu in twelve hours.

The Lockheed Constellation's four Wright Cyclone engines are 18-cylinder, air-cooled radial units of the powerful 2,000-hp. series. Each is built in two banks of nine cylinders each. They are advanced models of the 2,000-hp. Cyclone 18's, which power the world's largest landplane and largest seaplane. All models of this engine have a displacement of 3,350 cu. in. The Cyclone 18 has the low weight ratio of 1.1 lbs. per hp. This weight ratio, plus low fuel consumption and high horsepower for take-off with heavy loads, is a factor in the long range of the Constellation.

These four Wright engines, mounted in an air frame of new aerodynamic efficiency are credited for the power that makes this performance possible, with new comfort to passengers in transport duty, because the Constellation is able to cruise at 20,000 ft. The pressurized cabin, heated or cooled according to climate and always air conditioned, will maintain the air density of the 8,000-ft. level, and in case of need the Constellation can rise to 35,000 ft. The

plane is said to be able to maintain a 25,000-ft. altitude on three of its engines and to fly at 16,500 ft. on only two.

The performance of the Constellation is attributed to its aerodynamic shape, perfected after exhaustive research by the Lockheed "conference system" of engineering, which pools the efforts of the engineering staff. Its speed, range, and load-lifting ability are related directly to the Lockheed Lightning P-38 fighter. Aerodynamically, the Constellation's wing is an enlargement of the Lightning's, embodying the same high lift, low drag, and flight characteristics. It permits the use of the Lockheed Fowler flaps to reduce landing speed to 77 m.p.h. and also a new "maneuvering flap" that gives the Constellation three distinct sets of performance characteristics. With flaps telescoped into the wing, the plane is prepared for maximum speed and distance; the maneuvering flap increases the lift of the wing so that the Constellation will climb rapidly out of a short field or maneuver at slow speed during icing conditions or bad weather; and the landing flap brings it in to the airport at reasonable speed.

The fuselage, chosen after eleven shapes had been developed and tested, resembles an airfoil itself and has the lowest drag consistent with its large cubic capacity. Circular in cross section, it has a slight fore-and-aft camber, which allows the optimum floor arrangement and a material shortening of the nose-wheel strut.

The hydraulics of the Constellation were tested as carefully as its aerodynamics, with a full-scale "hydraulic mock-up" in the Lockheed laboratories. This permitted the functions of the plane to be checked at substratospheric temperatures down to −70°F. and under closely simulated service conditions.

Spot-welding technique has been largely used in this airplane, with about 75 per cent of the exterior surface of the fuselage and 10 per cent of the wing spot welded.

As a luxury airliner, the Constellation eventually could possibly be equipped to seat 60 passengers in comfort, with stations for pilot, copilot, flight engineer, navigator, and radio operator, as well as service attendants. Seats will be convertible to berths in flight, and ample food lockers and lavatory space are provided. A telephone system connects all doors and crew stations, and cargo space is located beneath the floor and in the nose, partitioned from the passenger compartment by fireproof bulkheads.

Trainer Developed from a Bomber

A veteran of the global war has become a trainer of America's youthful airmen. Similar to the Lockheed Hudson bomber, production of which is continuing, a new trainer known as the AT-18 is now in production at the Lockheed Aircraft plant. The AT-18 is being made in two versions: One is a gunnery trainer, while the other is a navigation trainer.

Based on the Hudson III, the AT-18's primary function is the training of advanced students in aerial gunnery. Most of the interior equipment of the Hudson has been removed and the cabin has been stripped down to a shell within which are seats, interphone equipment, and regulation Air Forces radio for a crew of two and one student. A low-pressure oxygen system is provided, and there is a target windlass installation that lets the target sock out through the tunnel gun opening.

The Boulton-Paul turret as used by the R.A.F. in the Hudson has been replaced by a Martin turret in which the student practices firing two 50-caliber machine guns at a wind sock trailed behind another AT-18. The trainers take turns firing at one another's windsock targets.

The function of the other version of the AT-18 is to train students in a course in aerial navigation. It also is stripped of all standard Hudson equipment but carries no turret or armament of any kind. Stations are provided for a crew of two and three student. The instructor is usually a member of the crew.

The standard Hudson instruments are duplicated on a panel inside the cabin in plain view of the students' swivel seats. These, together with other instruments near by, include an air-speed indicator, a clock, a thermometer for registering the temperature of air outside the cabin, an altimeter, a directional gyro, and a compass. Above the desk of each student there is an astrograph, or map of the stars, and in the roof of the cabin there is a navigation dome in which the students are taught how to take their bearings with a sextant.

In both of these versions, the AT-18 is powered by two G2O5A Wright Cyclone engines, the same as those used on the Hudson III. Lockheed Aircraft Corporation.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

N.A.S.C. Annual Report

In connection with the publication of its annual report for 1942, the National Aircraft Standards Committee has issued booklets outlining its organization, function, and operation. These cover the nature of the work of the committee, its schedule, and its responsibilities. The report contains a review of the activities of the Committee during the year.

Heating Process Speeds Aircraft Production

Heating a propeller blade shank for two important forming operations in approximately one-fifth the time formerly required is said to have resulted in a timesaving procedure of substantial proportions.

The propeller shank is heated by the Tocco process of heating by electrical induction, a method originated and perfected by The Ohio Crankshaft Company, Cleveland, Ohio.

The blade is mounted on a movable rack at the front of the 100-kw. Tocco machine. The tubular shank section of 4.625 in. diameter at the base of the blade is then moved forward until it is surrounded by the heat-inductor coils of the Tocco unit.

When the operator presses the control button, electrical current of high frequency flows through the inductor coils. This sets up internal molecular friction in the 12.625-in. section of the steel propeller shank, heating it to approximately 1,700°F. in 150 sec. When the correct temperature is reached, the operator hooks the blade on an overhead spring balance crane and conveys it to a National forging machine capable of producing a 27-ton pressure.

With the shank positioned in the dies of the machine, the operator depresses a foot lever, thus opening and closing the dies in quick succession. Each time the dies open, the operator turns the propeller shank about one-quarter of a revolution. As pressure is thus applied around the entire circumference of the shank, it is swaged into a true cylindrical shape.

At the completion of the swaging operation, the blade passes through two welding processes, a thorough inspection, and a lathe machining operation before it is again mounted on the movable rack and heated a second time in the Tocco unit for 210 sec. to a temperature of about 2,200°F. When the proper heating is attained, the overhead crane again conveys the heated piece to the adjacent upsetting equipment in a few seconds.

The upsetting operation consists of forming the heated shank in a three-pass set of dies to increase the wall thickness of the shank from 0.52 in. to

Curtiss

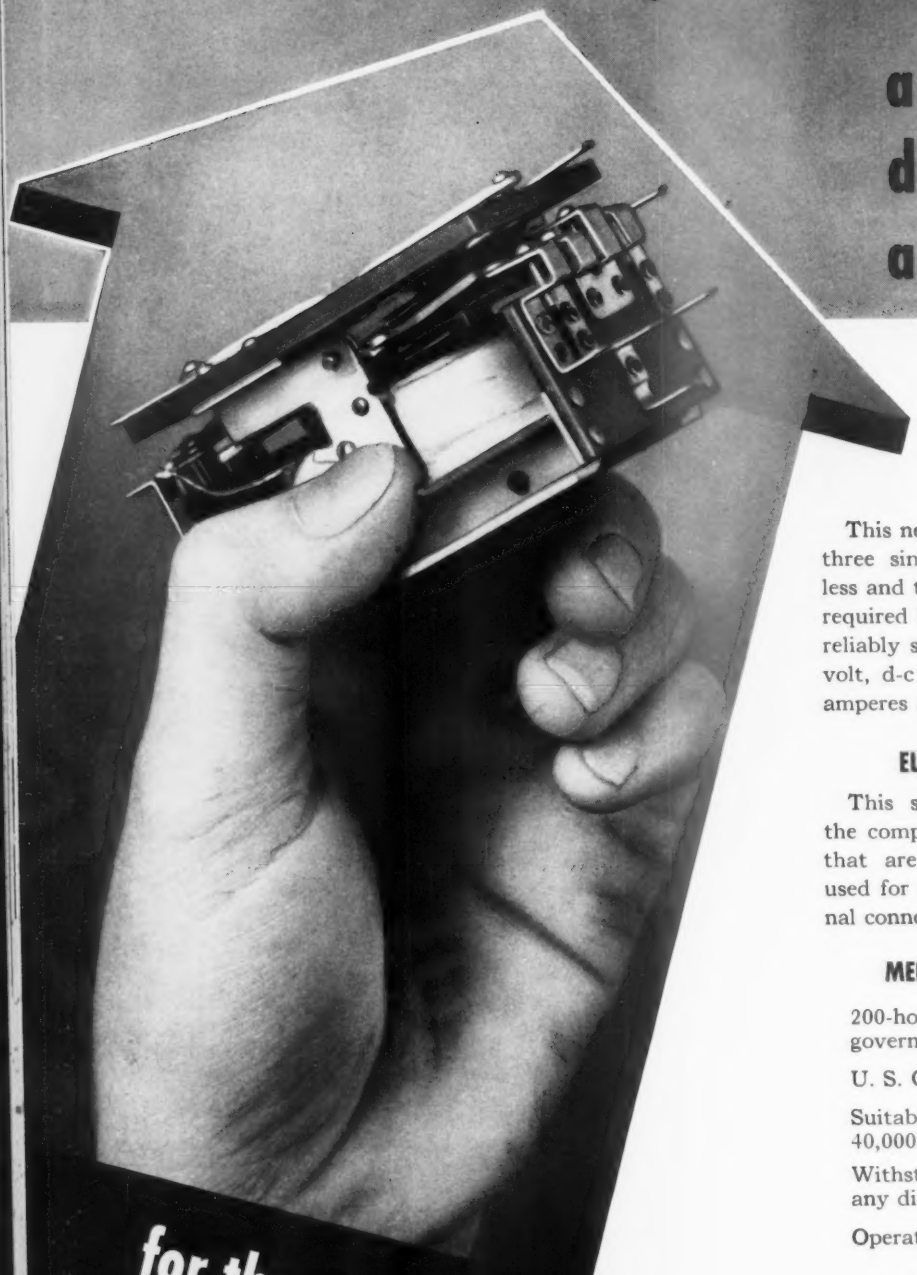
AUTOMATIC SYNCHRONIZER

Simplified Four Engine Control Through Automatic Propeller Synchronization

CURTISS
ELECTRIC PROPELLERS

For The First Time

a reversing dynamic-braking aircraft contactor



for the control of 12- or 24-volt series wound d-c motors

SAVES SPACE AND WEIGHT

This new G-E contactor takes the place of at least three single-purpose relays. Weighing considerably less and taking up only a small fraction of the space required by the relays it replaces, this contactor will reliably start, dynamic-brake, and reverse 12- or 24-volt, d-c motors having full-load currents up to 10 amperes and locked-rotor currents up to 60 amperes.

ELIMINATES COMPLICATED INTERLOCKS

This small, lightweight contactor eliminates all the complicated electrical and mechanical interlocks that are required when single-purpose relays are used for reversing and dynamic-braking. A few terminal connections are all that are necessary to install it.

MEETS THESE U. S. GOVT. REQUIREMENTS

200-hour salt-spray test as stipulated by various government agencies.

U. S. Government vibration stipulations.

Suitable for use at altitudes from sea level to 40,000 ft.

Withstand linear acceleration of 10 G applied in any direction.

Operate at temperatures from −40 C to 95 C.

FREE—AIRCRAFT CONTROL BULLETINS

A collection of well-illustrated bulletins which give full details on the new General Electric line of aircraft control. Yours for the asking—all in a durable binder. Just send a card requesting your copy—later bulletins on new devices will be mailed to you when issued. Address: *General Electric, Schenectady, N. Y.*

The Army-Navy "E", for Excellence in the manufacture of war equipment, now flies over six G-E plants employing 100,000 men and women.

GENERAL ELECTRIC

676-85-5480

approximately 0.8125 in. and to decrease the length of the shank area from 12.625 in. to 9.1875 in.

Brushes Used in Engine Overhaul

As a result of its brush engineering research, The Osborn Manufacturing Company, Cleveland, O., has been able to recommend changes in production and maintenance methods in which rotary power brushes of many different types have been adopted. On some production lines, power brushes made of fiber, cord or wire have served as secondary machine tools. They have been effective in preparing metal for welding and for cleaning metal after welds have been made. Osborn brushes are now being used to remove burrs, scratches, and tool marks from highly stressed parts of airplanes and to round corners and blend surfaces. They have been applied in connection with overhaul work on internal-combustion engines. Some of the overhauling jobs worked out by Osborn researchers were the cleaning of carbon, rust and other contamination for miscellaneous dismantled engine parts; cleaning of carbon deposits from the inside domes of engine cylinder heads; removing grease, oil, and dirt from carburetor housing; cleaning carburetor small parts and accessories for inspection; removing eroded metal from magnesium alloy crankcase parts; removing burned oil from crankshafts and polishing them; removing paint and rust from the outside of spark plug barrels; cleaning and removing rust from magneto, generator, and distributor parts and accessories.

For cleaning carbon deposits from the inside domes of cylinder heads, Osborn developed a special brushing device to increase the efficiency of the job by 40 per cent. The cylinder to be cleaned is mounted on a flexible yoke on a horizontal carriage that moves the cylinder forward onto a power brush. The motor drives a disc-shaped brush made up of 0.008 steel wire. A slightly oscillating motion of the cylinder in the flexible yoke permits the brush to reach all parts of the cylinder where carbon is deposited. The brush may be of various sizes, having outside diameters of $4^1/_2$, $5^3/_4$, $6^1/_8$ in., driven at 1,200 r.p.m. When the brush is worn, it can quickly be replaced with a refill. Other miscellaneous engine parts that have become rusted or caked with carbon may be cleaned by the Osborn monitor sections, special end brushes, and other power and hand brushes.

High-Speed Turret Mill

A new special high-speed Rogers vertical turret mill has been designed for boring, drilling, and turning nonferrous castings and forgings in aircraft and similar high-speed, high-production industries.

Adaptability of the new mill is increased by the swivel side head that is adjustable at any angle each side of vertical up to 35° to facilitate quicker tool setting for irregularly shaped pieces. A built-in graduated dial saves time in making setups for original and second runs. The horizontal chuck is said to permit the work to slide easily and quickly into exact position in a minimum amount of operator's time and subsequent reduction of mill "down time."

The main drive sheave of this high-speed model runs at 760 r.p.m. which is double the speed of the standard Rogers vertical turret mill, but both models have the same working capacity of 36 in. diameter. Rogers Machine Works, Inc., Buffalo, N.Y.

New Burr Remover for Aircraft Sheets

A method for removing burrs from blind-side holes in aircraft skin sheets has been found in a new burr remover produced by the Scovill Manufacturing Company, Waterbury, Conn. This small cutting tool, called the Scovill Burzit skin sheet burr remover, is said to quickly slice off blind-side burrs. First, the spring is compressed and the burr remover is inserted in the rivet hole. Spring pressure pulls the blade back against the skin sheet, and one clockwise turn of the tool removes the burr. A flat bearing section on the blade prevents the cutter from countersinking or thinning the sheet. Burzit burr removers are furnished for $^3/_{32}$, $^1/_8$, $^5/_{32}$, and $^3/_{16}$ in. rivet holes, each fitted in a special wood container, size-marked for identification and storage.

Automatic Boost Control

Designed to relieve the pilot of the need for manually adjusting the manifold pressure of his engines while flying at varying altitudes, Simmonds-Hobson automatic boost control units are now being shipped by Simmonds Aerocessories, Inc., for installation on aircraft going to the fighting fronts.

In wide use on English planes, although comparatively new in this country, the Simmonds-Hobson boost control can be described as an automatic manifold pressure regulator or power control. Although the installation of boost controls in fighter planes has greatly accelerated development of power control, aeronautical engineers are predicting a wide application for power control in civilian aviation after the war.

The Simmonds-Hobson boost control of the Mark 40 type, which is used as an adjunct to supercharged engines, in addition to simplifying the pilot's job, is said to prevent possible damage to the engine as a result of the development of excessive manifold pressure.

The control includes a small bellows or capsule of extreme sensitivity, enclosed in a housing connected to the engine manifold, with a servo piston and oil slide valve that connects to the engine oil systems. With the increase of manifold pressure, the bellows contract causes the slide valve to move, opening oil ports that allow oil to flow to one side of the piston, resulting in closing the throttle partly and maintaining the predetermined manifold pressure.

Hydraulic Speedpress

A new Speedpress (Hydraulic Arbor Press) has just been announced by Studebaker Machine Company, Chicago, Ill. It is entirely foot-controlled, leaving the operator's hands free for the work. No hand levers are required.

Pressures from 0 to 20,000 lbs. are obtained by the hydraulic control base that is placed in any convenient position underneath and connected with the press by steel tube. One movement of the applicator pedal and the ram moves downward to make contact with the work. Another foot pressure on the booster pedal and any holding grip desired up to 20,000 lbs. is applied. A release pedal breaks the pressure, and the ram automatically returns to the top of its travel. Release takes less than a second.

Many kinds of work are handled by the new Studebaker machine: broaching, assembling, piercing, oil-grooving, riveting, sizing, flanging, staking, forcing, small die tryouts, forming and pressing operations, and other jobs in industrial plants, machine shops, repair shops, garages, etc.

Attachment of Wire Bundles—Pulley Brackets

Tinnerman Harness Clamp 3044SF is provided with latching means to hold wire bundles together during subassembly and while transporting to final location (eliminating taping or boggles). There is also a slotted hole in the top leg of the clamp which makes possible the replacement of wires without dissembling the entire attachment. By loosening the screw a turn or two and compressing the clamp until the top leg clears the screw head, the clamp may be opened while still attached to the structure.

The clamp is made of spring steel, with Parkerized and gray enamel paint finish. It is covered with extruded synthetic rubber cushion, having integral resilient ribs that permit the absorption of variations occurring in many harnesses.

A line of Tinnerman Universal Pulley

ARMOR

PROTECTIVE ARMOR PLATE FOR AMERICA'S FIGHTING AIRCRAFT

• Breeze Aircraft Armor Plate, manufactured by the Breeze Electric Furnace Process, is engineered in unusual shapes and sizes to meet designers' special requirements. Light in weight, this armor plate affords maximum protection to the vital parts of our fighting aircraft with the minimum sacrifice of speed and maneuverability. In quantity manufacture today, Aircraft Armor Plate supplements the Breeze line of aircraft accessories that are playing such an important part in the United Nations' drive to Victory.

BREEZE CORPORATIONS, INC. BREEZE MAP **NEWARK, N. J.**

Brackets is available for AN-210 pulleys, sizes 1 to 6. They are furnished completely assembled with the exception of pulley, which is usually supplied and installed by the aircraft manufacturer. They are intended to eliminate the built-up brackets or cages that were custom-made for virtually every location. Only one hole is necessary for each bracket attachment and small stampings may be used for group installations. Full 360° rotation of base and 10° tilting of pulley strap facilitate cable alignment. The brackets are available with or without guards for attachment to structures from 1/8 to 1 1/2 in. in thickness.

An alphabetical list has been compiled of suggested typical nonstructural Speed Nut attachments, intended to serve as a guide to locations and parts of an airplane that can be fastened with these nuts. While the list is not offered as final or complete, it has been discussed with the Experimental Engineering Section, Matériel Center, Wright Field, which made no objection to the use of Speed Nuts in attaching the items listed, provided they are used in accordance with the criteria established in the *Handbook of Instructions for Airplane Designers*. It is stated that Speed Nuts are made to A.A.F. Specifications 25533 and are not to be used in primary structures, primary controls, and other vital or stressed parts.

In addition to the list of applications, tables are included covering the recommended safe loading values for various sizes of Speed Nuts. Tinnerman Products, Inc., Cleveland, O.

Life Raft Has New Safety Features

An improved seven-man rubber life raft that will give aviators forced down at sea added protection and comfort, including a square rigged sail, was announced recently by United States Rubber Company. The boat was designed by the Equipment Laboratory of the A.A.F. Matériel Center, Wright Field, working in collaboration with the company, and will be put into use on Flying fortresses.

Numerous improvements, both in construction and equipment, grew out of the experience of those who have been rescued at sea after spending weeks in inflatable boats. The new design not only gives more space but makes the boat less tippable and more seaworthy. A fabric sea anchor will be used to keep the nose of the boat into the wind and thus reduce the possibility of tipping caused by heavy seas. A horizontal bulkhead divides the boat into upper and lower chambers so that the entire boat will remain inflated even though pierced by a shark's teeth or other object from the bottom.

A sail is provided, as well as a tarpaulin with which the crew can protect itself from the elements. Besides the sail and wooden oars on which the sail may be rigged, equipment includes a fishing kit, emergency repair and signal kits, and first-aid equipment. These items together with concentrated rations for 30 days and in some boats a radio sending set supplied by the Army Air Forces, is placed in a special waterproof container secured to the floor of the boat. Other essential equipment, such as the sea anchor, bailing bucket, and plastic hand pump is tied individually by cord lines to the raft. Dimensions are approximately 12 ft. long and 5 ft. 8 in. wide, and weight, complete with equipment, is only 70 lbs. The boat deflated, with equipment, rolls into a carrying case 3 ft. long by 1 1/2 ft. in diameter.

The newly perfected Vultee flight test recorder.

Asbestos Fittings Replace Metals

The United States Rubber Company has announced a new type of asbestos fitting designed to take the place of critical metals in aircraft production. Designed in any shape or form required, the new product is made to withstand continuous heat of 350°F. or a temperature as low as −40°F.

Besides releasing large quantities of vital metals, the fittings are said to have marked advantages in sound-deadening and resistance to vibration. They are made from a woven form of asbestos fabric known as "Asbeston," which is considerably lighter than ordinary asbestos materials. They can be joined to ducts or hose by three methods: cemented, clamped by bands to metal sleeves inserted in both openings, or by the use of quick-grip couplings.

Uses already developed for the material are: carburetor air intake, heater hose nozzle, defroster attachment, gun blast boot, heat register, turbocooling fitting, air connector to supercharger, and many others.

The Vega Ventura Bomber

With many of its features still cloaked in wartime secrecy, the Vega Ventura bomber is in production on a seven-day, 24-hour schedule for the Army, the Navy and the British.

A military version of Lockheed's Lodestar, the Ventura embodies the conventional Lockheed design and closely resembles the Lockheed Hudson bomber. It is listed officially as a medium attack bomber of the type of the North American B-25 and Martin B-26.

Powered by two Pratt & Whitney double-Wasp engines of 2,000 hp. each, the Ventura is armed by machine guns protecting all vital points, as well as in the nose for ground strafing or attack purposes.

The Ventura carries a crew of four and has a range that varies according to the bomb load carried. While its range is secret, the Ventura is reported to have been flown across the Atlantic in considerable numbers. It has a wing span of 65 ft. 6 in., a twin tail with span of 25 ft. 10 in., and is 57 1/2 ft. in length. Vega Aircraft Corporation.

Test Flight Recorder

A new radio test flight recorder has been developed by engineers of Vultee Aircraft, Inc. The new device, a radio-operated mechanism, transmits from an experimental airplane to laboratory crews below reactions that occur too rapidly in high-performance aircraft for a test pilot's eyes and hands to notice and record. The fact that the radio recorder covers 70 points throughout the structure of the airplane makes it possible for the technicians to observe and record more structural and engine indications in one flight than hitherto have been possible to record in a score of such flights.

The radio test flight recorder is the invention of H. D. Giffen, former motion-picture sound engineer who now is on the Vultee staff of development engineers. It was perfected after 14 months of development work. In the recorder provision is made to record the indications of 70 pickup instruments, located in various parts of the airplane, in three-quarters of a second. Each of 70 indications may therefore be recorded once each three-quarter of a second for as long a period as desired, or a complete 70-instrument recording may be made at regular time intervals by means of an intervalometer. The reason for the latter arrangement is to economize on film and on the subsequent analysis time.

The recorder makes it possible to obtain a continuous, unbroken recording

The remarkable precision which characterizes modern aircraft production, finds its counterpart in the formulation and manufacture of Berryloid Aircraft Finishes. The uniformity and dependability of these famous finishes, carefully maintained by continuous laboratory tests and production control, play an important part in facilitating maximum Allied plane production. The most famous American and Canadian fighters, bombers and trainers are finished with Berryloid materials.

BERRY BROTHERS

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

BOSTON • JERSEY CITY • CINCINNATI • CHICAGO • ST. LOUIS • INGLEWOOD, CALIF.

MONTREAL • WINNIPEG • TORONTO

LET'S GO! KEEP 'EM FLYING

BERRYLOID

AIRCRAFT FINISHES

of any one instrument in order to study the strain, vibration and other characteristics of a rapidly changing function, making possible the study of control loads, hinge loads, air speed, and acceleration during dives, pullouts and other operations.

A switching arrangement permits continuous recording of as many as 15 instruments, one at a time, during a single flight. A flight test of unlimited duration may be recorded, with the airplane as far as 100 miles from the receiving instruments.

Among the indications reported by the scattered pickup units are air speed, engine manifold pressure, altimeter, tachometer (both engine and turbosupercharger), flowmeter, accelerometer, temperature indication (fuel, oil, air, engine, coolant), liquid pressure gauges (fuel, oil, cooling liquid, etc.), air pressure gauges (carburetor ram, radiator cooling airflow, engine-cooling airflow, airfoil pressure survey, etc.), strain (control-cable loads, hinge loads, and other structural loads), push-pull control rod loads, position and movement indicator (control surfaces, cowl flap, landing gear, wing flaps, etc.).

The instrument indications are transformed by equipment located in the airplane into an electrical frequency in audio range. The frequency of each signal depends upon the voltage of the pickup, the voltage itself being a function of the instrument indication. This signal frequency is transmitted over an audio-frequency radio, which may be the standard equipment of the airplane, to the ground where it is automatically recorded. Recording is accomplished by a standard 16-mm. sound recorder or, in the case of continuous indications, by a standard high-fidelity disc recorder.

Analysis of the frequencies recorded on the sound film or on the disc plate is accomplished automatically by a device that not only analyzes each signal but also plots the analysis on a paper chart. Each of the 70 functions is plotted automatically on a separate chart so that the flight engineers have a complete charted analysis of the entire flight. In the case of continuous recording, the resultant automatically plotted chart is a continuous chart of whatever variations occurred on that particular function during the period recorded.

Reclaimer for Salvaging Aircraft-Engine Oil

Equipment is being built by the Youngstown Miller Company, Sandusky, O., for several of the large aircraft-engine builders to be used in salvaging quantities of high-grade oil drained from aircraft engines. One such machine, which will soon be installed at an aircraft-engine plant, is said to have a capacity of 55 gal. of dirty oil in 70 to 80 min., but the reclaimers are built with smaller and larger capacities. In several plants the reclaimers now in operation salvage 2,500 gal. of lubricating oil per 24-hour day. These plants also use the reclaimers to handle hydraulic oils.

In operation, dirty oil is sent to the reclaimer by a motor-driven pump that has an automatic float control that controls the quantity pumped into the machine. The operator next adds a bulk refiners earth and starts the electric heaters and agitator motor. When the mixture of heated oil and earth reaches the proper temperature, signal lights indicate to the operator when the batch is ready for delivery to finished tanks through the filter press that separates the oil from the dirty earth. The earth remains, together with the contaminants it has removed from the oil, in the filter press as a dry cake.

Small Angle Heads

A new line of "junior" size angle drilling heads is now available, designed for production drilling, countersinking, and other operations in close quarters. These new Wyco angle heads are used on a flexible shaft or flexible shaft extension of a portable electric drill. They come with 90°, 45°, 30° or universal heads, have overall diameters of $^1/_2$ or $^3/_4$ in., and are used in the manufacture of aircraft. Wyzenbeek & Staff, Inc., Chicago, Ill.

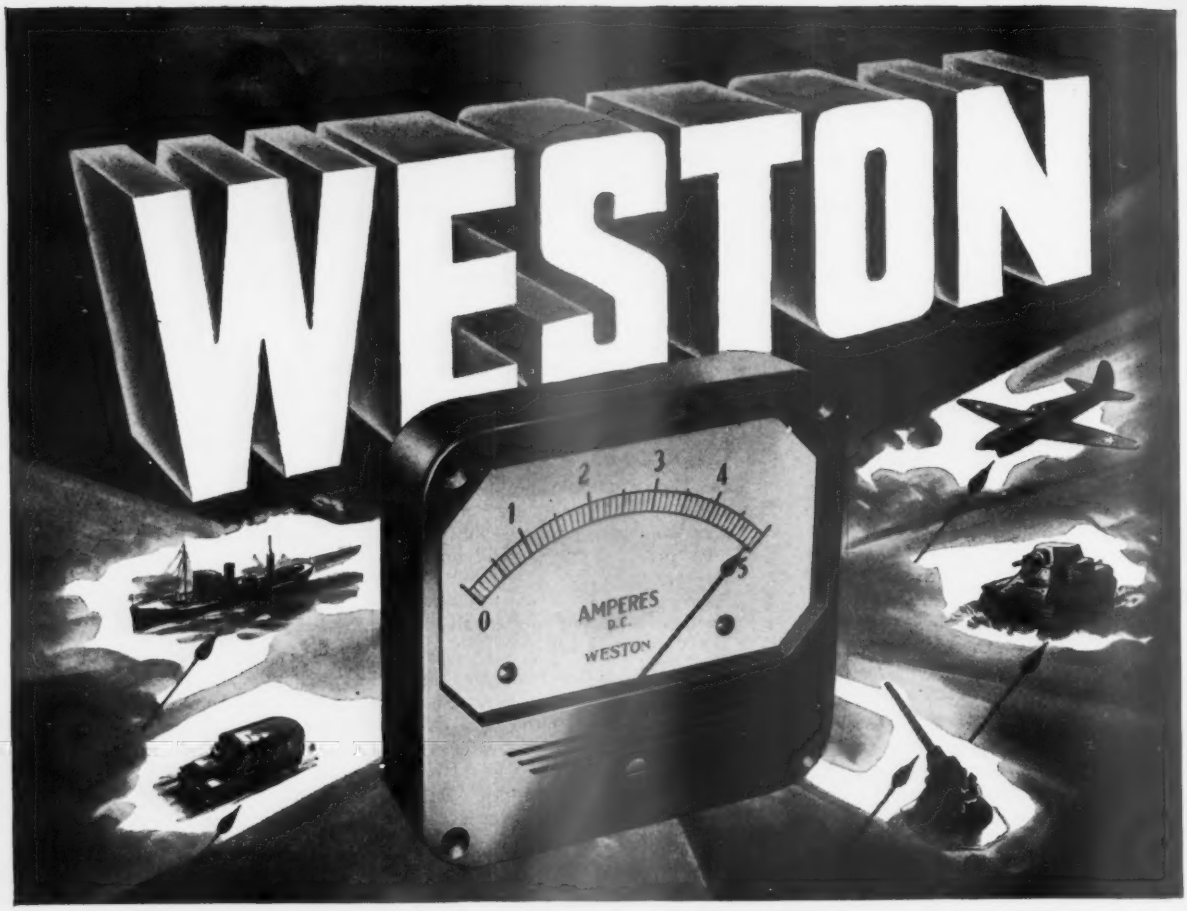
The Technical Information Service
of the
Aeronautical Archives
of the Institute of the Aeronautical Sciences

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports and general surveys of any aeronautical subject.

Research work is charged at the usual library fee of $2.00 per hour. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers at the standard rate of 1c per word. Minimum charge, $2.00.

Reproductions of any material in the Aeronautical Archives of the Institute may be ordered at standard photostat rates.



Doing the same fundamental Job in 1943 but so much more of it!

ARMY E NAVY

Most manufacturers engaged in war production are working on products foreign to their normal efforts. But it's a different story here at WESTON. We have exactly the same job to do because our job is *so fundamental;* but there's much more, *so much more of it.* For precise measurement is vital to the efficient functioning of equipment in *all* branches of a highly mechanized war machine. And while measurement fundamentals have not changed, the universal preference for instruments the way WESTON builds them *has not changed either.*

So WESTON'S job, as we enter the New Year, still remains the job of striving to keep abreast of the country's unprecedented and critical instrument needs. Production has been increased many fold through expanded and scattered manufacturing facilities. And the curve *continues* upward. But never to the point where we must relinquish, *one bit,* our quality standards — 'else some pilot's safety might be *less* secure . . . a ship's reckoning *less* accurate . . . a critical power plant *less* efficient.

But achieve the production goal *we will;* without jeopardizing quality . . . without interrupting our continuing development program now focused on instruments to help speed victory. And in accomplishing this goal, we will have equipped ourselves to serve *even better* the new and increased instrument needs of the future . . . the needs of American industry at peace. Weston Electrical Instrument Corporation, 625 Frelinghuysen Avenue, Newark, New Jersey.

Laboratory Standards . . . Precision DC and AC Portables . . . Instrument Transformers . . . Sensitive Relays . . . DC, AC, and Thermo Switchboard and Panel Instruments.

WESTON

Specialized Test Equipment . . . Light Measurement and Control Devices . . . Exposure Meters . . . Aircraft Instruments . . . Electric Tachometers . . . Dial Thermometers.

FOR OVER 54 YEARS LEADERS IN ELECTRICAL MEASURING INSTRUMENTS

Institute of the Aeronautical Sciences Eleventh Annual Meeting

FINAL PROGRAM

The program below lists those papers presented at the Technical Sessions of the Eleventh Annual Meeting of the Institute, held simultaneously in New York, Detroit, and Los Angeles during the week of January 25–29, 1943.

Individuals desiring preprints of papers for personal use should make their requests directly to the authors of the papers desired.

AERODYNAMICS

Chairmen:

NEW YORK—**Hugh L. Dryden,** National Bureau of Standards
DETROIT—**Arnold M. Kuethe,** University of Michigan
LOS ANGELES—**A. L. Klein,** Douglas Aircraft Company, Inc.

Aspect Ratio Corrections—K. D. Wood, Purdue University
Aerodynamic Problems of the Towed Glider—Alexander Klemin, New York University, and W. C. Walling, Lockheed Aircraft Corporation
Characteristics of Airfoils in a Cylindrical Axial Flow Grid—John R. Weske and F. E. Marble, Case School of Applied Science
Torsional Aileron Flutter—Zbigniew Krzywoblocki, Polytechnic Institute of Brooklyn
Maneuverability Criteria Through Turning Performance—John E. Goode, Jr., Douglas Aircraft Company, Inc.
Compressibility Effects on High Speed Airplanes—Clarence L. Johnson, Lockheed Aircraft Corporation

AIRCRAFT PRODUCTION

Chairmen:

NEW YORK—**Guy A. Luburg,** Brewster Aeronautical Corporation
DETROIT—**John Tjaarda,** Briggs Manufacturing Company
LOS ANGELES—**Arthur E. Raymond,** Douglas Aircraft Company, Inc.

The Economic Transition of Aircraft Production—G. M. Giannini, Vega Aircraft Corporation
Perspective Illustration as Applied to Aircraft Design and Production—Arthur M. Fitzpatrick, Stinson Aircraft Division, Vultee Aircraft, Inc.
The Plastic Working of Magnesium Alloy Sheet—C. E. Lehnhardt, The Dow Chemical Company
Progress in Aircraft Plywood—Thomas D. Perry, The Resinous Products & Chemical Company
Photoprint Reproductions in Aircraft Lofting—Philip Taber, Brewster Aeronautical Corporation
One Example of Graphic Management Control—Bureau of Aeronautics, Navy Department

AIRPLANE DESIGN

Chairmen:

NEW YORK—**Fred E. Weick,** Engineering and Research Corporation
DETROIT—**E. A. Stalker,** The Dow Chemical Company
LOS ANGELES—**B. C. Boulton,** Lockheed Aircraft Corporation
Comfortization of Military Aircraft—Albert A. Arnhym, Pacific-Airmax Corporation
A New Method of Longitudinal Control for Aircraft by Use of an Adjustable Angle of Attack Balance—Roland J. White, Airplane Division, St. Louis Plant, Curtiss-Wright Corporation
Passive Defense—The Protective Armoring of Military Aircraft—Horace J. Alter, Consulting Engineer
Designing Aerodynamic Surfaces by the Use of Algebraic and Trigonometric Functions to Permit Easy Manufacture—John J. Apalategui and W. B. White, Douglas Aircraft Company, Inc.
The Relation of X-Ray Testing to Aircraft Design—L. W. Ball, Triplett and Barton, Inc.

AIR TRANSPORT

Chairmen:

NEW YORK—**William Littlewood,** American Airlines, Inc.
DETROIT—**William B. Stout,** Stout Engineering Laboratories, Inc.
LOS ANGELES—**Walter R. Jones,** Lockheed Aircraft Corporation

---

Pressurizing Low-Altitude Airplanes—Charles W. Morris, Airesearch Manufacturing Company
Developing Maximum Efficiency in the Operation of Long Range Air Transports—William M. Masland, Pan American Airways System
Engineering of Power Control and Altitude Selection in Airline Operation—Dixon Speas, American Airlines, Inc.

MATERIALS

Chairmen:

NEW YORK—**Charles H. Colvin,** New York University
DETROIT—**Peter Altman,** Vultee Aircraft, Inc.
LOS ANGELES—**J. R. Goldstein,** Douglas Aircraft Company, Inc.

Design-Strengthened Sheet Metal—Richard S. Smith, Rigid-Tex Corporation, and Hamilton Gray, New York University.
Thin Case Hardening with Radio Frequency Energy—V. W. Sherman, Federal Telephone and Radio Corporation
On the Torsional Damping Capacity of Solid Magnesium Alloy Rods as Affected by Cold-Working—A. U. Kutsay and A. J. Yorgiadis, The Pennsylvania State College
Mechanical Properties of Austenitic Stainless Steels—R. A. Lincoln, Allegheny-Ludlum Steel Corporation
Elevated Temperature Aging of 24S Aluminum Alloy—Paul P. Mozley, Lockheed Aircraft Corporation
Use of Magnesium in German Aircraft—H. W. Schmidt, The Dow Chemical Company

METEOROLOGY

Chairmen:

NEW YORK—**Athelstan F. Spilhaus,** New York University
DETROIT—**Clarence J. Root,** United States Weather Bureau
LOS ANGELES—**Beno Gutenberg,** California Institute of Technology

MERIAM

Announces THE "8 in 1" MANOMETER

AN AIRCRAFT INSTRUMENT TEST MANOMETER

★ This manometer, Model A-338, has an extensive application in laboratory and field servicing for checking calibration to determine functioning of aircraft instruments, in particular:

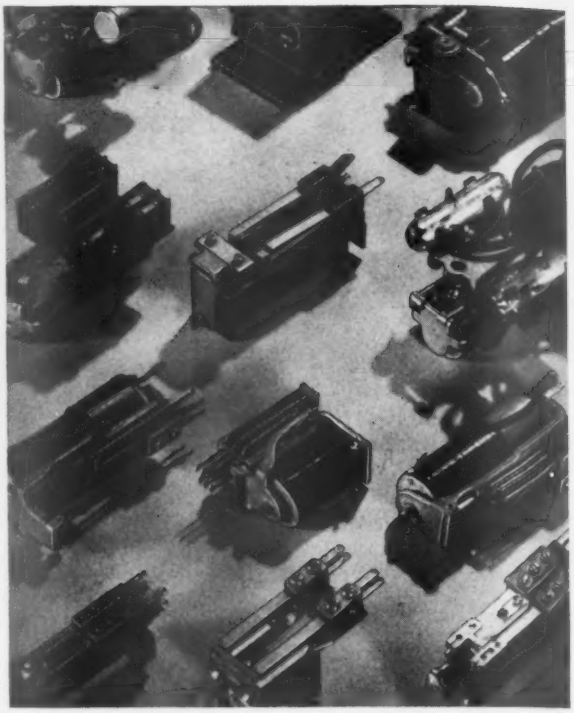
- **Altimeters**
- **Air Speed Indicators**
- **Rate-of-Climb Indicators**
- **Fuel Pressure Gauges**
- **Manifold Pressure Gauges**
- **Suction Gauges**
- **Automatic Pilot sylphons and actuating diaphragms; etc.**

The instrument is of the direct reading well type design incorporating an eight sided scale selector, permitting the selection of proper scale for particular aircraft instrument being checked. All scales are adjustable to suit barometric conditions in any specific locality and are direct reading in miles per hour-knots-pounds-inches-millimeters, etc. The range is from 0 to 61 inches of mercury or water. An integral return well prevents loss of indicating fluid.

The manometer is fully described in Bulletin 22. Copy will be mailed on request.

THE MERIAM COMPANY
1991 West 112th St. Cleveland, Ohio

MERIAM
SINCE 1911
★
MANOMETERS, METERS AND GAUGES FOR THE ACCURATE MEASUREMENT OF PRESSURES, VACUUMS AND FLOWS OF LIQUIDS AND GASES



CAN RELAYS SOLVE YOUR *Electrical Control* PROBLEMS?

IF SO, which type? How will it be used? What combination of coils and contacts will be needed? These and similar questions on electrical control are facing makers of war products every day. There's an easy, sure way of getting the right answer—

You can obtain skilled aid in selecting the right relay, stepping switch or other control part for your product by calling in an Automatic Electric field engineer. He can place at your disposal the technique gained through a half-century of experience in the design and application of control devices. He can help you save design time, reduce your costs, insure reliability of your product.

Helpful, too, is our new 80-page catalog—a storehouse of useful data on electrical control apparatus and its uses. Write us for your copy, or telephone our nearest office.

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, Ill.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

A Spectrophotometric Hygrometer—L. W. Foskett and H. B. Foster, Instrument Division, United States Weather Bureau

Lightning Phenomena—G. D. McCann, Westinghouse Electric & Manufacturing Company

Cloudiness and Precipitation in Relation to Convergence—James M. Austin, Massachusetts Institute of Technology

Non-Instrumental Determinations on the Ground of Ceiling, Icing Layers, Turbulence, and Winds Aloft—Charles F. Brooks, Blue Hill Observatory, Harvard University

Gustiness Under Various Weather Conditions—S. P. Ferguson, Blue Hill Observatory, Harvard University

The Determination of Vertical Velocities in Thunderstorms—C. E. Buell, American Airlines, Inc.

Applications of the Vertical Shear Vector to Upper Air Analysis—Robert D. Fletcher, U.S. Weather Bureau.

PHYSIOLOGIC PROBLEMS

Chairmen:

NEW YORK—**Otis O. Benson, Jr.,** U. S. Army Aero Medical Research Laboratory

DETROIT—Arnold D. Tuttle, United Air Lines Transport Corporation

LOS ANGELES—**Eaton M. MacKay,** Scripps Metabolic Clinic

Medical Activities in Naval Aviation—James C. Adams, Bertram Groesbeck, Jr., and Eugene F. DuBois, U. S. Navy Bureau of Medicine and Surgery

Medical Activities in Military Aviation—David B. Dill, Otis O. Benson, and W. Randolph Lovelace, II, U. S. Army Aero Medical Research Laboratory, Wright Field

Vision, Hearing and Aeronautical Design—L. D. Carson, Medical Research Section, Bureau of Aeronautics, U. S. Navy; Walter Miles, Yale University Medical School; S. S. Stevens, Harvard University

Limits of Human Heat Regulation—Louis H. Newburgh, University of Michigan; L. P. Herrington, John B. Pierce Laboratory of Hygiene; A. P. Gagge, U. S. Army Aero Medical Research Laboratory, Wright Field

Oxygen Requirements and Equipment in Aviation—Detlev W. Bronk, University of Pennsylvania; E. G. Hall, Royal Canadian Air Force; Eaton MacKay, Scripps Metabolic Clinic

Medical Research in Some Aspects of Aircraft Design—William E. Russell, Boeing Aircraft Company; F. E. Poole, Lockheed Aircraft Corporation; Hugh DeHaven, Cornell University Medical College

POWER PLANTS AND PROPELLERS

Chairmen:

NEW YORK—**C. Fayette Taylor,** Massachusetts Institute of Technology

DETROIT—**Ralph N. Dubois,** Packard Motor Car Company

LOS ANGELES—**Lon Storey, Jr.,** Lockheed Aircraft Corporation

---

The Volumetric Efficiency of an Internal Combustion Engine—John Markell, Jr., and C. F. Taylor, Massachusetts Institute of Technology

A Tabular Method of Propeller Blade Stress Analysis—Joseph Stuart, III, Aeroproducts Division, General Motors Corporation

The Horsepower Meter for Aircraft—J. C. Luttrell, Air Transport Command, Army Air Forces; S. A. Petrasek, American Airlines, Inc.

Study of Exhaust Valve Design from Gas Flow Standpoint—Seng-chiu Hu, Vought-Sikorsky Aircraft Division, United Aircraft Corporation

Problems of Routine Propeller Balancing—Jere T. Farrah, American Airlines, Inc.

Temperature Effects on Turbine Supercharger Installation—Philip Colman, Lockheed Aircraft Corporation

RADIO AND INSTRUMENTS

Chairmen:

NEW YORK—**C. S. Draper,** Massachusetts Institute of Technology

DETROIT—**F. N. M. Brown,** University of Notre Dame

LOS ANGELES—**W. Lavern Howland,** Lockheed Aircraft Corporation

---

Altimeter Setting Indicator—Charles H. Colvin, New York University

Resonant Electrical Control Systems—David W. Moore, Jr., Fairchild Aviation Corporation

Pioneer Magnesyn Remote Reading Compass—Donald W. Smith, Pioneer Instrument Division, Bendix Aviation Corporation

Graphical Analysis of Delay of Response in Airspeed Indicators—K. J. DeJuhasz, The Pennsylvania State College

Vultee Radio Recorder—Harvey D. Giffen, Vultee Aircraft, Inc.

A Multiple Recording Manometer—Paul J. Campbell, United Aircraft Corporation

ROTATING WING AIRCRAFT

Chairmen:

NEW YORK—**Alexander Klemin,** New York University

DETROIT—**E. A. Stalker,** The Dow Chemical Company

A Method for Rapid Estimation of Helicopter Performance—Quentin Wald, United Aircraft Corporation

Helicopter Model Engineering—Its Relationship to Development and Utilization of Military and Commercial Helicopters—W. F. Gerhardt, Air Transport Command, Army Air Forces

Aerodynamic Considerations of Rotors in Hovering and Vertical Climb Conditions—Charles H. Kaman, Hamilton Standard Propellers Division, United Aircraft Corporation

Control for Helicopter Rotor—E. Burke Wilford, Pennsylvania Aircraft Syndicate, Ltd.

Progress of the Vought-Sikorsky Helicopter Program in 1942—I. I. Sikorsky, Vought-Sikorsky Aircraft Division, United Aircraft Corporation.

STRUCTURES

Chairmen:

NEW YORK—**Joseph S. Newell,** Massachusetts Institute of Technology

DETROIT—**George H. Tweney,** University of Detroit

LOS ANGELES—**F. R. Shanley,** Lockheed Aircraft Corporation

Significance of the Secant and Tangent Moduli of Elasticity in Structural Design—D. S. Wolford, The American Rolling Mill Co.

General Instability of Monocoque Cylinders—N. J. Hoff, Polytechnic Institute of Brooklyn

Experimental Investigations in Aircraft Dynamics—William B. Bergen, The Glenn L. Martin Company

Effects of Yielding and Perforations on Wing Tension Surface—Richard K. Koegler and Arthur Schnitt, Airplane Division, Buffalo Plants, Curtiss-Wright Corporation

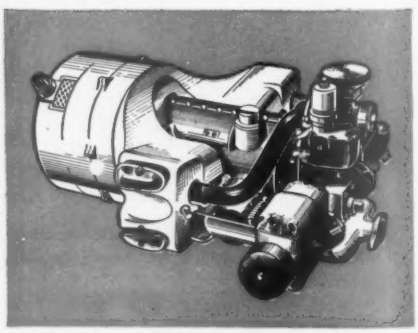
Strain Energy Analysis of Incomplete Tension Field Web-Stiffener Combinations—Paul H. Denke, Douglas Aircraft Company, Inc.

Form Factors for Metal Parts—Frank P. Cozzone, Lockheed Aircraft Corporation

Buckling of Aluminum-Alloy Columns and Plates—Henry L. Langhaar, Consolidated Aircraft Corporation

Tension Joints—Clarence Holleman, Boeing Aircraft Company

AS the mighty PT boats of the U.S. Navy roar into action, they carry with them their own source of vital electricity – Lawrance Auxiliary Power Plants. These portable powerhouses, compact and light in weight, are designed to meet modern combat demands for a reliable flow of current to operate gun turrets, torpedo hoists, radio, lights, and galley hot plate. Lawrance Auxiliary Power Plants have been in action since Pearl Harbor; have given many thousands of hours of dependable, attention-free performance. Being produced today in ever-increasing quantities for aircraft as well as PT boat installations, Lawrance Auxiliaries are playing an important role in America's drive to Victory.



Lawrance Auxiliary Power Plant
Model 30C-3
Length 32¾"; Width 24"; Height 15".
Normal continuous power output 5KW.
Maximum overload capacity 7½ KW.

Lawrance
AUXILIARY POWER

LAWRANCE ENGINEERING AND RESEARCH CORPORATION • LINDEN, NEW JERSEY

Institute News

Institute Officers for 1943

Officers of the Institute for 1943 have been elected by the Council as follows:

President—Dr. Hugh L. Dryden, Chief of Mechanics and Sound Division, National Bureau of Standards.

Vice-Presidents—J. L. Atwood, Executive Vice-President, North American Aviation, Inc.; E. R. Breech, President, Bendix Aviation Corp.; Sherman M. Fairchild, Chairman of the Board, Fairchild Engine & Airplane Corp.; Earl D. Osborn, President, Edo Aircraft Corp.

Executive Vice-President—Lester D. Gardner.

Treasurer—Elmer A. Sperry, Jr., Vice-President, Sperry Products, Inc.

Secretary—Robert R. Dexter.

Assistant Treasurer—George R. Forman.

Controller—Joseph J. Maitan.

Members of the Advisory Board for 1943 and four new members of the Council, will be announced in the March issue of the Review.

Fellows for 1942 Elected

In balloting concluded in December, 1942, ten members of the Institute were elected Fellows. To qualify as a Fellow of the Institute, a member must have been an Associate Fellow for at least a year and "he shall have attained a position of distinction in aeronautics. He shall have made notable and valuable contributions in one of the aeronautical sciences or aeronautical engineering."

Nominations for Fellowship are made by the present American Fellows and Honorary Fellows, who number 110. Not more than ten members may be elected Fellows each year. They are chosen by secret ballot of the Fellows and Honorary Fellows.

The Fellows elected are:

Frederic Flader, Chief Engineer, Airplane Division (Buffalo Plant) Curtiss-Wright Corporation.

R. F. Gagg, Assistant to General Manager, Wright Aeronautical Corporation.

Paul E. Hovgaard, Chief Research Engineer, The Glenn L. Martin Company.

Clarence L. Johnson, Chief Research Engineer, Lockheed Aircraft Corporation.

Dr. Arthur L. Klein, Associate Professor of Aeronautics, California Institute of Technology; Consulting Engineer, Douglas Aircraft Company, Inc.

John G. Lee, Assistant Director of Research, United Aircraft Corporation.

William T. Schwendler, Vice-President and Chief Engineer, Grumman Aircraft Engineering Corporation.

T. E. Tillinghast, President and Director, United Aircraft Service Corporation.

Lt. Comdr. P. V. H. Weems, U.S.N. (Ret.), Weems System of Navigation.

John B. Wheatley, Chief Development Engineer, The Glenn L. Martin Company.

Robert M. Losey Award to F. W. Reichelderfer

The recipient of The Robert M. Losey Award for 1942 is F. W. Reichelderfer, Chief of the U.S. Weather Bureau. It was given for his pioneering work and continuing activity in advancing the science and practice of meteorology as applied to aeronautics, with particular recognition of the development under his direction of the network and system of upper air sounding by radiosonde.

This Award, established by the Institute in 1940, honors the memory of Capt. Robert Moffatt Losey, one of its members and a meteorologic officer in the Air Corps. He was killed at Dombas, Norway, April 21, 1940, while serving as an official observer for the U.S. Army, He was the first officer in the service of the United States to be killed in World War II.

The Losey Award is given "in recognition of outstanding contributions to the science of meteorology as applied to aeronautics." Mr. Reichelderfer was chosen by a Committee of Award consisting of: Dr. Robert A. Millikan, Chairman of the Executive Council, California Institute of Technology; Dr. Karl T. Compton, President, Massachusetts Institute of Technology; Dr. Lyman J. Briggs, Director, National Bureau of Standards; Edward H. Bowie, President, American Meteorological Society; Hall L. Hibbard, President of the Institute for 1942; and Lester D. Gardner, Executive Vice-President of the Institute.

An officer since 1918 in the U.S. Navy, in which he now holds the rank of Commander (Retired), numerous meteorologic assignments, particularly in connection with naval aviation, provided Commander Reichelderfer's extensive experience in the science of weather forecasting before he became Chief of the U.S. Weather Bureau in January, 1939.

He was graduated from Northwestern University; was a meteorologic officer in the Navy stationed in Nova Scotia in 1918 and at Hampton Roads, 1919–1922; and served at Lisbon in connection with the first trans-Atlantic flight of the NC-4 Navy flying boats in 1919. From 1922 to 1928 he was in charge of organization and expansion of naval meteorologic work and then served until 1931 as a meteorologic officer at the Navy airship station at Lakehurst and was later Executive Officer of this station. In addition to various duties throughout this period, he had several assignments on special meteorologic projects in the United States and Europe.

In the past four years, under Commander Reichelderfer's direction, many noteworthy developments have been made in the activities of the U.S. Weather Bureau. The meteorologic services for civil airways of the United States and Alaska have been greatly expanded so that there are now approximately 650 surface airways weather reporting stations, 125 pilot balloon stations for observing winds at flight levels, and 50 radiosonde stations for determining the atmospheric elements that are significant in direct air-mass analysis for airways weather forecasting. Extensive use of upper air observations by the radiosonde, an instrument that automatically transmits weather data by radio as it is carried aloft by a balloon, has been an important element in the more general use of advanced air-mass analysis in the Bureau's regular practice.

Improvements have been made in other instruments and in the engineering techniques of weather forecasting. Much attention has been given by the Bureau to the establishment and encouragement of facilities for advanced professional education in meteorology, and it has engaged in intensive in-service training for its meteorologic personnel and extension of meteorologic education

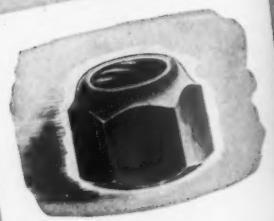
Drawn by Clayton Knight

FIVE REASONS WHY BOOTS IS A BETTER NUT

1. Lighter weight.
2. Greater re-usability.
3. Unaffected by oil, gasoline, marred bolt ends, or cross-drilled bolts.
4. Effective under high temperatures, low temperatures, and sudden temperature changes.
5. Has approval of all Government agencies for aircraft or engine construction.

THESE PLANES FLY WITH THEIR BOOTS ON

Boeing Flying Fortress.
Brewster Buccaneer.
Cessna Trainer.
Consolidated Liberator, Coronado, Catalina.
Curtis Commando, Dive Bomber, Plywood Plane, Scout Observation Planes.
Edo Floats.
Fairchild Trainers.
Grumman Wildcat, Avenger.
Martin Bomber, Flying Boat.
North American Mustang.
Republic Thunderbolt.
Vultee Trainer, Vengeance Dive Bomber.
Waco Glider.



FOR ENGINE MANUFACTURERS

The **Rol-Top** "hex" nut, latest addition to the Boots Self-Locking Nut family. Specially designed for engine application, the **Rol-Top** Nut does its job under higher temperatures, exposure to gasoline and other destructive elements

They Fly with their Boots on— a million lbs. lighter!

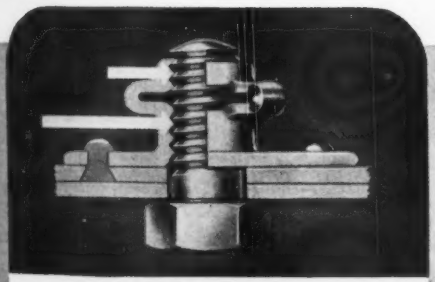
Fighter planes, bombers, cargo planes, trainers, gliders . . . all types of aircraft today "fly with their Boots on." And, because of this fact, they'll fly lighter—*by a million pounds.* For Boots Self-Locking Nuts—the important anchor and channel types—are stamped from sheet metal.

Besides making America's planes a million pounds lighter, they *save* a million pounds in strategic metals.

Government authorized, self-locking nuts . . . all-metal . . . "lighter and everlasting". . . therefore better in operation and maintenance.

Today engine manufacturers are making extensive use of another Boots item—the "Rol-Top," all-metal nut.

All of which means that we have *better* planes, and *lighter* planes . . . with less consumption of metal, when they fly with their Boots on.



HOW IT WORKS

The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction . . . locking threads are out of lead with load carrying threads of lower section.

Upon insertion of bolt, top section of nut is extended to engage with threads of bolt. A constant force is thus established which locks nut firmly into position. Axial thread play is eliminated.

BOOTS

Boots Aircraft Nut Corporation

Self-Locking Nuts for Application in All Industries

GENERAL OFFICES: NEW CANAAN, CONNECTICUT

Doing double duty FOR WAR

. . . N-A-X *9100 Series*

Our Navy's submarines are the only units of our armed forces that fight in two elements—on the surface of the sea, and under it. Torpedoing Jap warships, or shelling Axis ports, these deadly "steel fish" are continually in action.

N-A-X 9100 Series of Alloy steels see plenty of action, too, for every pound produced finds its way quickly into vital war equipment. Because of its unusual properties, N-A-X 9100 Series met many exacting peace-time applications in parts for trucks, buses, freight cars, truck-trailers, road building equipment, construction machinery and hundreds of other uses. Today, these same characteristics make this versatile steel a valuable asset in the manufacture of war material.

Steel users interested in conserving critical alloys without sacrificing quality will find the N-A-X 9100 Series ideal. It is supplied in two general grades, with and without molybdenum, with all strategic elements carefully balanced and held to an absolute minimum. N-A-X 9100 Series is truly a fighting alloy steel that conserves vital alloying elements—thus doing double duty for war.

GREAT LAKES STEEL CORPORATION
Detroit, Michigan
Sales Offices in Principal Cities

NATIONAL STEEL

Division of
NATIONAL STEEL CORPORATION
Executive Offices · Pittsburgh, Pa.

SCRAP IS VITAL TO STEEL PRODUCTION . . . GET YOURS IN FOR VICTORY!

J. L. Atwood
Vice-President

Dr. Hugh L. Dryden
President

E. R. Breech
Vice-President

Sherman M. Fairchild
Vice-President

Officers of the Institute for 1943

Earl D. Osborn
Vice-President

Lester D. Gardner
Executive Vice-President

Elmer A. Sperry, Jr.
Treasurer

Robert R. Dexter
Secretary

Follow the center line . . .

The early birds who flew by the seat of their pants are fast fading away in the wake of the development of scientific flying. Gone are the days when a pilot had to feel his way to the air-port through pea soup fog.

The contribution of electronics to instrument flying is of first importance. Through radio communications, blind landing systems and a host of newer developments which cannot be revealed during wartime, air travel has rapidly blossomed.

Yesterday Eimac electronic tubes earned their "wings" in the ground stations of the nations leading airlines. *Today* military aviation is building Eimac's flying hours to a record high. *Tomorrow* Eimac's new developments perfected and employed to win the war will be released to the tremendously expanded peace-time air services.

Eitel-McCullough, Inc., San Bruno, California

Follow the leaders to

Eimac TUBES

Awarded for high achievement in the production of war materials.

for career students in Government service and in private employ.

Octave Chanute Award to A. Lewis MacClain

The Octave Chanute Award for notable contributions to the aeronautical sciences made by pilots has been awarded by the Institute to A. Lewis MacClain, aircraft-engine test pilot and engineer of the Pratt & Whitney Aircraft Division, United Aircraft Corporation. The Award was made "for outstanding work in the flight testing of aircraft engines and the development of the engine torque indicator."

The committee that chose the recipient of the Chanute Award consisted of: Lt. Gen. H. H. Arnold, Commanding General of the Army Air Forces; Rear Adm. John S. McCain, Chief of the Navy Bureau of Aeronautics; Dr. Lyman J. Briggs, Director of the National Bureau of Standards; Hon. L. Welch Pogue, Chairman of the Civil Aeronautics Board; Dr. George W. Lewis, Director of Research of the National Advisory Committee for Aeronautics; Hall L. Hibbard, President for 1942 of the Institute; and Lester D. Gardner, Executive Vice-President of the Institute.

The Award honors the memory of the American engineer, Octave Chanute, who died in 1910. He was a pioneer in aeronautical research and gave assistance and advice to the Wright brothers in their early work.

Albert Lewis MacClain was born in Auburn, N.Y., November 14, 1894. He enlisted as an aviation cadet in the United States Army Air Service in December, 1917, while a student at Whitworth College, Spokane, Wash. He was commissioned a 2nd Lieutenant and served as a flying instructor until his discharge in May, 1919. His schooling was continued at the University of Washington, where he received a B.S. degree in mathematics in 1920 and B.S. in Mechanical Engineering in 1925. Work for an M.S. in Aeronautics was completed at the Massachusetts Institute of Technology in 1927.

He continued his flying training in the Air Corps Reserve during these college years and was an aerial photographer and flying instructor for the Boston Airport Corporation in 1927–1928. From 1928 to 1938 he was chief test pilot and aeronautical engineer for Pratt & Whitney Aircraft and did work for Hamilton Standard Propellers and other divisions of the United Aircraft Corporation. During this time he developed and organized the Flight Test Section of the Engineering Department.

In 1938 he represented United Aircraft in Europe and in 1939 served in France as a test pilot for the French Air Ministry. On his return to the United States he became installation engineer and test pilot for Pratt & Whitney and developed the flight test group, which he heads, to study engine installation and operation problems.

Dr. E. C. Schneider Named for John Jeffries Award

Dr. Edward C. Schneider, Professor of Biology at Wesleyan University since 1919, has been selected to receive The John Jeffries Award for 1942 given by the Institute for his pioneering research in the field of aviation medicine, particularly the development of the Schneider Physical Fitness Index, a method that has been in use for over 20 years in Army, Navy, and civil aviation for testing the condition of pilots.

The John Jeffries Award is given annually "for outstanding contributions to the advancement of aeronautics through medical research" and is named after Dr. John Jeffries, a Boston physician, who was the first American to make scientific observations from the air. He made a flight from London with Blanchard, the French balloonist, in 1784 and took recordings of the temperature, humidity, and density of the air. In January, 1785, Dr. Jeffries was Blanchard's passenger in the first aerial crossing of the English Channel, which was made in a balloon whose construction he had financed.

The Committee that chose the recipient of the Jeffries Award for 1942 consisted of: Dr. George W. Lewis, Director of Research, National Advisory Committee for Aeronautics; Gill Robb Wilson, President, National Aeronautic Association; Edgar S. Gorrell, President, Air Transport Association of America; Major W. Randolph Lovelace, President, Aero Medical Association; Hall L. Hibbard, President of the Institute for 1942; and Lester D. Gardner, Executive Vice-President of the Institute.

Dr. Schneider began his work in aviation medicine in November, 1917, when he was made physiologist in charge of the Medical Research Laboratory in Washington to investigate conditions that affect aircraft pilots and provide tests and apparatus to counteract the ill effects of high-altitude flying. For a number of years previously he had been engaged in studies of the physiologic reactions to high altitude at Colorado Springs and Pike's Peak and in 1911 was a member of the Anglo-American Pike's Peak Expedition studying mountain sickness and adaptation to high altitudes.

The aeromedical laboratory was moved to Hazelhurst Field, Long Island, N.Y., early in 1918, and a school for training flight surgeons was established, its first courses of study being arranged by Dr. Schneider. In August of that year a group of about 30 officers trained at the school were sent abroad for duty with the American Expeditionary Forces and established an aeromedical laboratory at Issoudun, France. They were headed by a Medical Research Board of four of which Dr. Schneider, then a Major, was a member.

It was at this laboratory, about 150 miles from the battle front, that the Schneider Physical Fitness Index was developed and first put into use. It is a system of scoring men as to health and physical fitness by a simple standardized test of the heart and circulatory condition of the individual at rest and after a prescribed amount of activity.

C. E. Sinclair Resigns from Institute Staff

C. E. Sinclair, Secretary of the Institute since 1939, resigned on January 1 to go into military service. Enlisted in the Air Corps Reserve, he is now taking flight training for the Army Air Forces in the C.A.A. War Training Service. Mr. Sinclair joined the staff of the Institute in December, 1933, the year following its organization. He had previously been with the N.A.C.A. at the Langley Memorial Aeronautical Laboratory.

He was succeeded in office by Robert R. Dexter, elected Secretary for 1943. Mr. Dexter, a graduate of the Daniel Guggenheim School of Aeronautics at New York University, has been on the Institute staff for the past seven years. He was responsible for the greater part of the technical work of editing and classification necessary to set up the Institute's Aeronautical Index, publish the Bibliography of Aeronautics, and establish The Paul Kollsman Library. He was Managing Editor of the AERONAUTICAL ENGINEERING REVIEW, is Associate Editor of the JOURNAL OF THE AERONAUTICAL SCIENCES, and is in charge of programs for technical meetings of the Institute.

New Corporate Members

During the past month the following companies have become Corporate Members of the Institute:

Adel Precision Products Corporation. Adel Precision Products Corporation manufactures more than 3,000 types and sizes of aircraft equipment. Among its contributions in the field of hydraulic mechanisms, the company makes more than 100 different units including 60 separate types of hydraulic four-way selector valves

This is the way to win a battle in the desert

Libya and North Africa made it clearer than ever: THIS IS A WAR OF SUPPLY.

In 1918, an American soldier could be equipped and maintained on 5 tons of supplies each year.

But today, for every soldier sent abroad, *10½ tons* of shipping space must be provided for *equipment alone.* And it takes an additional *18 tons of shipping to supply a single soldier for a year!*

Supply is a matter of *ships.*

And ships need electricity.

Vast quantities of electric power, for a thousand vital tasks that must be done to take a convoy safely across the seas...

Electricity to steer the vessels and operate the radios and signal lights.

Electricity to detect the approach of enemy subs and planes, to sound the alarm, to organize the defense.

Electricity to power great cargo winches, and delicate navigating instruments.

Electricity to make magnetic mines harmless, to provide invisible "black light" for reading charts at night. Electricity to keep food fresh, to cook it, to ventilate the ships, to provide comfort for the crews.

Electricity in every freighter, every tanker, every Navy escort vessel—to help win the war of supply!

We of Westinghouse take tremendous pride in building so much of the electrical equipment, so many of the great turbines and gears and electric drives, for the ships of America's Navy and Merchant Marine.

Into every piece of that equipment go all our "know-how," all our skill, all our determination to *do our share* in this war—and if possible, a little more.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Tune in the Westinghouse Program starring John Charles Thomas — NBC Network, Sunday, 2:30 P. M., Eastern War Time.

Westinghouse

PLANTS IN 25 CITIES — OFFICES EVERYWHERE

built on six basic designs. Standardization permits 90 per cent interchangeability of parts. In addition, the company makes line circuits, fuel injection pumps, anti-icing systems, and allied equipment.

Adel is credited with having originated numerous products, such as the Mighty Midget, four-way selector valve, said to be lighter in weight and smaller than former models, and the Stacking Midget that makes possible multiple-valve outlet installations in limited spaces such as in cockpit control panels. A rubber compound developed by Adel called "Adelite" is said to save 50 per cent in synthetic rubber and 33 per cent in weight when used for aircraft installations.

An affiliated company makes line-support clips and blocks and the "Sta-loc" hose clamp. The company maintains branch engineering offices to render regional consulting service for users of its products.

Beech Aircraft Corporation. Beech Aircraft Corporation, manufacturer of light and medium aircraft, is currently producing three types of airplanes.

The twin-engined, all-metal, twin-rudder light transport is built in several versions for the Army Air Forces and the Navy Bureau of Aeronautics: a bombing trainer, a long-range navigation trainer, a personnel transport, and a photographic airplane. All of these are adaptations of the commercial Beechcraft transport.

The single-engined Beechcraft biplane is a negative-stagger, wood-wing, welded steel tubing fuselage design almost identical with the commercial model. This serves the Army and the Navy as a light transport and utility airplane.

The plywood, twin-engined Army type AT-10 advanced pilot trainer was designed for the specific purpose of transition training and utilizes a minimum of critical materials. Other designs are in process of development but information about them is restricted.

Bolton Manufacturing Corporation. The Bolton Manufacturing Corporation was organized in March, 1941, and now produces radio ignition shielding harnesses for military aircraft engines. The corporation operates several plants in three important industrial centers in Connecticut.

The Fafnir Bearing Company. The Fafnir Bearing Company was one of the pioneers in the development of ball bearings designed expressly for aircraft control systems. Quality has been the aim of the company's precision methods of manufacture and inspection for material, dimensions, race contours, and finishes. In addition to quality material and precision methods, Fafnir products are characterized by double seals, prepacking with lubricant, corrosion resistance through the use of cadmium plate or stainless steel, and inner ring hub extension for side clearance.

McDonnell Aircraft Corporation. The McDonnell Aircraft Corporation was organized in 1939 for the design and production of commercial and military aircraft. It is currently engaged entirely in war production work under contracts with the Army Air Forces, the United States Navy, and with other aircraft manufacturers. These contracts cover production and experimental aircraft as well as aircraft parts and assemblies. Plants are located in Missouri and Tennessee.

In addition to its work on conventional aircraft structures, the company has pioneered in the development and use of laminated paper plastic for both primary and secondary aircraft structures.

Another phase of the company's activities has been extensive experimentation in vibration carried on under assignment by the United States Government.

The Parker Appliance Company. This company manufactures standard and special aircraft fittings, valves, couplings, engine primers, and hydraulic equipment including turret elevating mechanisms. The company's machine tool division produces a line of hand-operated and power-operated tube bending machines, tube flaring machines, tube beading machines, and automatic hydraulic cable stretchers. It is fully engaged in war work and 97 per cent of its total production is used by the aircraft industries in oil, gasoline, hydraulic, instrument, and deicer circuits. The remaining 3 per cent of output is used in the machine tool, chemical, and power-plant industries.

Roosevelt Field, Inc. Roosevelt Field, Inc. is the owner and operator of Roosevelt Field, widely known as one of the oldest privately owned airports in the United States. The company also owns and operates the Roosevelt Aviation School, which has been training pilots and mechanics for more than 13 years.

Flight training has been discontinued for the duration of the war, but the school is at present actively engaged in operating a mechanics' training course for civilians and is also training airplane mechanics for the United States Army Air Forces Technical Training Command.

Solar Aircraft Company. This company has specialized for 13 years in the design and manufacture of installations for the disposal or utilization of airplane-engine exhaust gases. Many modern military and commercial aircraft are equipped with exhaust systems designed and built by Solar.

The company is pioneering in the development of heat exchangers, flame dampers, jet propulsion stacks, heaters, and turbosupercharged installations. Representatives of the company are strategically located in various cities.

United States Rubber Company. The United States Rubber Company is one of the nation's largest manufacturers of vehicle tires and a wide variety of rubber products for industrial, medical, household, and other uses. Since the early days of the airplane industry, it has been engaged in the development and production of specially designed products for aircraft.

The company is a leading manufacturer of rayon tires for airplanes, bullet-sealing fuel cells and hose, molded and extruded rubber goods, asbestos air ducts, special yarns and fabrics, and synthetic rubber.

In cooperation with the leading military aircraft manufacturers, the company is now engaged in intensive research and has developed new materials and products intended to increase airplane safety and performance under combat conditions. Its years of experience, in addition to current developments under the stimulation of military necessity, should result in a greatly expanded list of parts and auxiliary equipment for the aeronautical industry of the future.

Whiting Corporation. Whiting Corporation, Aviation Division, specializes in the design and manufacture of auxiliary equipment to facilitate maintenance and handling operations, including cargo handling for aircraft manufacturers and commercial airlines. With its staff of experienced aircraft engineers and its background of many years of successful experience in material-handling and lifting problems for railroad shops and general industry, Whiting is prepared to work effectively in solving maintenance and handling problems in the aeronautical industries resulting from the rapid expansion and frequent changes encountered in those industries.

At present such items as propeller dollies, engine dollies and stands, engine transfer carriages, hydraulic wing and axle jacks, bomb hoists, brake testing apparatus, etc., are in use.

C26S—Shielded

CHAMPION SPARK PLUGS are the

dependable source of full, flowing engine performance, so vital to a Navy pilot at that crucial moment when an enemy ship—the never-to-be-forgotten prize, looms large in his sights. Champions are on active duty on every front.

C26—Unshielded

Reports are continuously flowing into our offices citing service records of the outstanding performance, long life and extreme dependability of Champion Aircraft Spark Plugs, in engines of every type and size.

These case histories are gratifying to us and the results directly traceable to inherent qualities in materials and design which are the results of truly exhaustive research and engineering over a long period.

Champion manufactures spark plugs, and spark plugs only, and has always backed its products with exclusive facilities and personnel, without equal in the spark plug industry. We believe that is why Champion Spark Plugs are synonymous with dependability, throughout the world.

Characteristic Advantages of Champion Ceramic Insulation Are—

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

Sections and Branches

Detroit Section

The monthly dinner meeting of the Detroit Section was held on Wednesday, January 6. The speaker of the evening was Professor Edward T. Vincent, of the University of Michigan, who delivered a lecture on "Cooling the Aircraft Engine."

The lecture covered not only the cooling characteristics of air-cooled and liquid-cooled engines but also dealt with design features that have a bearing upon proper cooling. Comparisons were made of the two types of engines with particular reference to operations at extremely high altitudes.

San Diego Section

The first meeting of the San Diego Section for the 1942–1943 season on December 18 received an excellent response, having an attendance of 525. Interest in the organization was evidenced by the application of 67 as Section Associates and 30 who submitted their names for national membership.

The meeting was opened by Chairman E. G. Stout, with the presentation of several motion pictures obtained from the industrial training department of Consolidated Aircraft Corporation. The first three pictures shown were *Combat Shots, Fighter Pilot,* and *Air Communique,* Official British Air Ministry pictures showing Spitfires and Hurricanes in action against enemy aircraft. Three other pictures *U.S. Navy Attack on Gilbert Islands, Bombing of Manila,* and *Pearl Harbor* showed the destruction caused by aircraft.

Frank Davis, Engineering Test Pilot of Vultee Aircraft, Inc., spoke on "Flight Characteristics of the British Spitfire and Hurricane Fighter Airplanes," based on his observations while assigned by the United States Government to the British Air Ministry.

University of Detroit

The monthly meeting of the Student Branch was held Thursday, November 19, 1942, following a dinner sponsored by the seniors. Among the guests were George Tweney and Philip Blenkush of the Faculty, as well as several underclassmen. In the absence of the chairman, Wilfred F. Bush, Secretary, presided.

After the showing of three industrial sound films, *How to Weld Aluminum, How to Machine Aluminum,* and *How to Rivet Aluminum,* Mr. Tweney gave the members an outline of forthcoming activities of the branch for the month of January. Sixty members participated in the meeting.

The University of Oklahoma

A joint meeting of the student branches of the Institute of the Aeronautical Sciences, the American Society of Mechanical Engineers, and the Society of Automotive Engineers was held in the Engineering Auditorium on December 10, with approximately 100 members of the three branches in attendance.

The I.Ae.S. Student Branch had charge of the entertainment. The film *Safe Flying,* provided by the N.A.C.A., was shown, and Alexander Fish of the South Naval Base spoke on the training of naval aircraft mechanics.

After the joint meeting the I.Ae.S. student branch held a business meeting, at which the following new officers were elected: Chairman—Claude Culp; Vice-Chairman—Tom Higgins, Jr.; and Secretary-Treasurer—Ben Cagle.

Purdue University

The first annual banquet of the Purdue Student Branch was held December 9, 1942, in honor of the graduating seniors. Sixty members were present.

The main speaker was Dr. A. M. Kuethe, Chairman of the Department of Aeronautical Engineering at the University of Michigan, who urged the students to keep the field of "pure research" in aeronautical design open, saying that the tendency to "freeze" designs of aircraft even during wartime is an unsatisfactory policy if carried to extremes.

Other speakers at the dinner were Lam-Tai Cheung, a graduating senior, who discussed the "Spirit of the Chinese Air Force," and Bob Kinney, who gave a synopsis of his thesis on "V-tailed" aircraft. Prof. E. H. Bruhn, the Honorary Chairman, gave a brief farewell address to the seniors on the conduct of a college graduate in industry. Other guests at the banquet were Profs. K. D. Wood, H. L. Solberg, and J. Liston.

At a meeting on December 19 the following officers were elected: Chairman—Paul Brink; Vice-Chairman—Robert L. Beebe; Secretary-Treasurer—Carl Hagenmaier. Only about 30 members were in attendance, since most of the seniors were not available, so consideration of business matters was postponed to a future meeting.

News of I.Ae.S. Members

L. Welch Pogue, Hon. M.I.Ae.S., has been reappointed by the President to the Chairmanship of the Civil Aeronautics Board, and **Edward P. Warner,** F.I.Ae.S. has been made Vice-Chairman of the Board.

Robert Insley, F.I.Ae.S., has joined Continental Motors Corporation as Engineer, having previously been Chief Engineer of Kinner Motors, Inc.

William B. Stout, F.I.Ae.S., has joined the Research Staff of Consolidated Aircraft Corporation. The Stout Engineering Laboratories will continue research work as the Stout Research Division of Consolidated.

George A. Allward, A.F.I.Ae.S., is the new Chief Engineer of Higgins Aircraft, Inc.

Walter C. Clayton, A.F.I.Ae.S., was recently appointed Coordinator of Engineering Education in the Engineering Department of Lockheed Aircraft Corporation.

Flavius E. Loudy, A.F.I.Ae.S., has received his commission as a Major in the U.S. Army Air Forces and is assigned to duty as Chief, Production Follow-Up Branch, Midwestern Procurement District.

William C. Rockefeller, A.F.I.Ae.S., recently became Chief of Aerodynamics and Preliminary Design at Avion Incorporated.

Col. John S. Allard, M.I.Ae.S., serving under Major Gen. James H. Doolittle in Africa, was decorated by Lt. Gen. Eisenhower with the Silver Star for meritorious service.

Marvin C. Demler, M.I.Ae.S., is now a Lieutenant Colonel in the Army Air Forces Matériel Command, Washington.

Randolph Hartley, Jr., M.I.Ae.S., was commissioned 1st Lieutenant, U.S. Army Air Forces.

Col. John H. Jouett, M.I.Ae.S., who resigned the presidency of the Aeronautical Chamber of Commerce of America to join the Higgins enterprises in New Orleans, is Vice-President and General Manager of Higgins Aircraft, Inc.

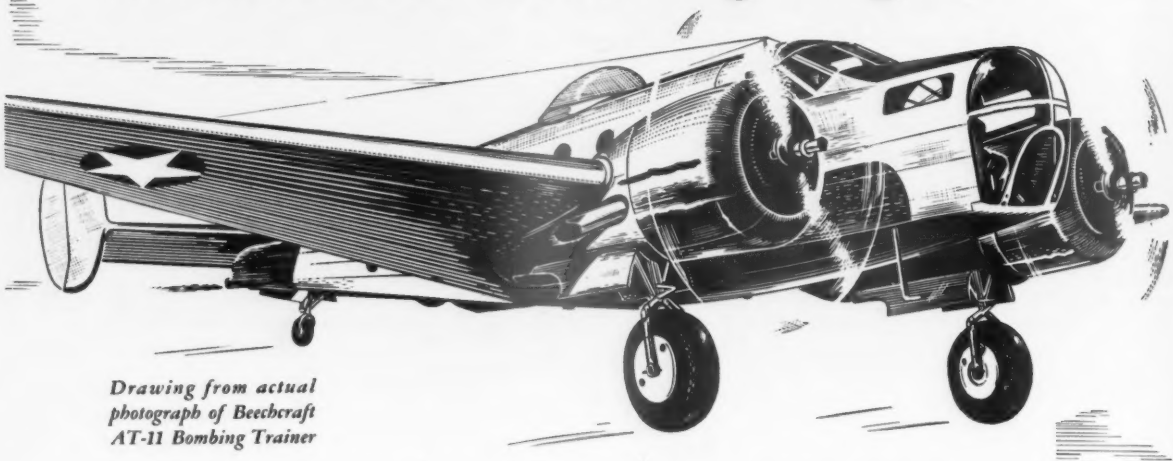
Eugene P. Resos, M.I.Ae.S., has been appointed Structural Research Engineer on nonstrategic materials at Vultee Aircraft, Inc.

Paul E. Richter, M.I.Ae.S., Executive Vice-President of T.W.A., Inc., has been called to active duty in the Navy as a Lieutenant Commander in the U.S. Naval Reserve. He has been assigned to the Naval Air Transport Service.

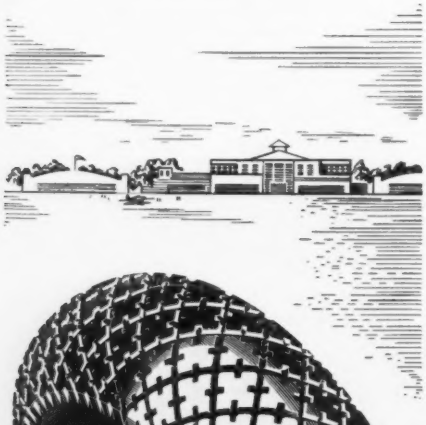
Malcolm J. Abzug was promoted to Assistant Aeronautical Engineer in the Army Air Forces at Wright Field, from his former rating as Junior Aeronautical Engineer.

Lilburn S. Barksdale, formerly with Lockheed Aircraft Corporation, has joined Adel Precision Products Corporation as Design Engineer.

Mission Accomplished . . . on Bomber Training Flights



Drawing from actual photograph of Beechcraft AT-11 Bombing Trainer



● Fledgling crews must accomplish countless bombing training missions at home before they are ready to take their place in America's far-flung armada of bombers.

Constant take-offs and landings by bombing trainers test the mettle of tires equally as much as heavy bombers themselves.

General Tires proved equal to their mission of safety on the flight to Tokyo . . . and they are proving that they have the quality and strength equal to the mission of standing the gaff on bombing training flights.

In every branch of wartime aviation, General's long practical experience in aviation tire manufacture is helping to bring the utmost in *safety*.

For your safety, too . . . depend on General.

See Your Fixed Base Operator or Write

THE GENERAL TIRE & RUBBER CO.

Aviation Division, Akron, Ohio

The **GENERAL** **AIRPLANE TIRE** —KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY

Ethan A. Berry has joined Empire Ordnance Corporation as Industrial Engineer, having formerly been Works Manager at the Chicago Pneumatic Tool Company.

Maurice H. Bigelow has been commissioned a Captain in the Chemical Warfare Service, United States Army, and assigned to Edgewood Arsenal.

John C. Buie is on leave of absence from Canadian Pacific Airlines having been commissioned P/S Lieutenant, Royal Canadian Naval Volunteer Reserve.

Alfred J. Carah, formerly Test Engineer at Douglas Aircraft Company, is now a Project Engineer.

Robert H. Coven has been appointed Junior Engineer for Northwest Airlines, Inc.

Leonard B. Edelman has become an Assistant at the Guggenheim Aeronautical Laboratory, California Institute of Technology, while working for his Master's degree in aeronautical engineering.

Merle C. Huppert has been transferred from the Langley Memorial Aeronautical Laboratory to the Aircraft Engine Research Laboratory of the N.A.C.A.

Leo J. Kujawa, Air Corps Engineering Officer on the staff of the Army Air Forces with the rank of 1st Lieutenant, is Resident Representative at the Willow Run Plant of the Ford Motor Company.

Salvatore LaRosa has joined Republic Aviation Corporation as Stress Analyst.

George W. Myron, formerly Instructor, Academy of Aeronautics, has been commissioned an Ensign in the U.S. Naval Reserve and assigned as an Aviation Engineering Specialist.

M. F. Newmark, Jr., is now Flight Test Engineer at Consolidated Aircraft Corporation.

John R. Palmer has joined Rearwin Aircraft & Engines, Inc., as Methods Engineer, having formerly been Manager of Contracts at Chicago Pneumatic Tool Company.

David W. Pearsall has been commissioned a 1st Lieutenant in the Army Air Forces and assigned to Experimental Engineering at Wright Field.

Donald E. Platz is now a Lead Engineer, Fuselage Group, Strickland Aircraft Corporation.

Alcide Santilli, Chief Engineer, Fiber Instrument Company, has been commissioned a Lieutenant in the Signal Corps of the U.S. Army.

Francis Shaw has joined the Airplane Parts Division of Glidden-Buick Corporation.

Eric Skelton was recently commissioned Lieutenant in the British Royal Navy and appointed as Technical Officer for Fleet Air Arm duties.

William H. Sydall has been appointed Service Supervisor at Rotol Airscrews Ltd. in England, having formerly been Service and Flight Test Engineer.

Ralph B. Tilney received his commission as Captain, U.S. Army Air Forces, and was assigned to the Air Transport Command, Africa Middle East Wing.

Joseph J. Ventura is now Stress Analyst at Northrop Aircraft, Inc.

John Wessale, formerly Aerodynamicist at North American Aviation, Inc., has become an Aviation Cadet in the U.S. Army Air Forces.

Ben F. Wilkes, Junior Research Engineer at Shell Development Company, has been commissioned an Ensign in the U.S. Naval Reserve.

Shown here studying plans for the new Research Laboratory, now being erected by Curtiss-Wright, are (*seated—center*) Dr. C. C. Furnas, formerly of Yale University, the newly appointed Director of the Laboratory; (*seated—left*) Dr. Norton Moore, Chief of the Aerodynamics Research, and codesigner of the Laboratory's new wind tunnel; (*seated—right*) W. E. Voisinet, Manager of the Research Laboratory. Standing (*left to right*) are C. G. Trimbach, Assistant Chief of Developments; E. S. Jenkins, Chief of Materials and Structures; and Peter F. Rossmann, Chief of the Developments Department. (*See* "From the Industry.")

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Gallant, Charles James, Technical Advisor to Pres. & Executive Vice-Pres., North American Aviation, Inc.

Garges, John Paul Donald, Ae.E.; Chief Engineer, Bristol Aeronautical Corp.

Tharratt, George, Chief Engineer, Adel Precision Products Corp.

Elected to MEMBER Grade

Bartnick, Joseph J., B.S. in Ae.E.; Asst. Director, Aero. Engineering School, Spartan School of Aeronautics.

Elggren, Stephen Bryant, Senior Flight Instrumentation Engineer, Flight Research Dept., Bell Aircraft Corp.

Hanley, William Vincent, M.E.; Engineering Pilot, Intercontinent Div., Transcontinental & Western Air, Inc.

Hurkamp, Charles Hartner, Jr., B.S. in M.E.; Development Design Engineer, Airplane Div., Curtiss-Wright Corp.

Mann, Robert Lee, B.S. in Ae.E; Director, Engineering School, Spartan School of Aeronautics.

Marchev, Alfred, Vice-Pres. & Gen. Mgr., Republican Aviation Corp.

Minor, Leonid A., Aero. Engineer, Grumman Aircraft Engineering Corp.

Nigut, Joseph Eugene, B.S. in M.E.; Aerodynamicist, Eastern Aircraft Div., General Motors Corp.

Peery, David J., Ph.D.; Assoc. Professor of Aero. Engineering, The Pennsylvania State College.

Raspet, August, Ph.D.; Research Physicist, Gould Aero. Div., Pratt, Read & Co., Inc.

Rhode, Richard Valentine, B.S. in M.E.; Principal Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Thorp, John Willard, Asst. Preliminary Design Engineer, Vega Aircraft Corp.

EDO FLOAT GEAR

SERVES THE UNITED NATIONS

On The Alaskan Front
. . . where the going is tough, the rugged all-metal construction of Edo Floats is meeting the requirements of almost unbelievably severe conditions of service.

★ ★ ★ ★ ★ EDO manufactures single and twin Float Gear for the aircraft of the U. S. Navy, U. S. Army Air Forces and leading Foreign Governments.

Edo Aircraft Corporation, 413 Second St., College Point, N.Y., U.S.A.

Transferred to MEMBER Grade

Bricker, Ethelbert Irvin, M.S. in Ae.E.; Research Asst. in Aeronautics, State Engineering Experiment Station.

Cerny, Richard Joseph, B.S. in M.E.; Development Engineer, Goodyear Aircraft Corp.

Douglas, Robert Bell, M.Sc.; Superintendent, Propeller Div., Canadian Car & Foundry Co. Ltd., Canada.

Dutton, Donnell W., M.S. in A.E.; Asst. Professor of Aero. Engineering, Georgia School of Technology.

Hall, Carl E., B.Ae.E.; Section Head, Structures Group, Arizona Div., Goodyear Aircraft Corp.

Hamlin, Benson, B.Ae.E.; Sr. Flight Research Engineer, Bell Aircraft Corp.

Johnson, Philip Oscar, B.S. in M.E.; Sr. Stress Engineer, Fisher Body Aircraft Section, General Motors Corp.

Markle, Edwin Gillian, Designer & Leadman, Douglas Aircraft Co., Inc.

Wickersham, Robert Owen, M.S.E.; Aero. Engineer, U.S. Army Air Forces, Matériel Command, Wright Field.

Elected to Industrial Member Grade

Gould, Leslie Douglas, Chief Inspector, Brewster Aeronautical Corp.

Hansen, Lauritz Angell, Principal Inspector, Sub Assembly Div., Republic Aviation Corp.

Holman, John Vivian, Manager, Aero. Dept., Sperry Gyroscope Co. Ltd., England.

Elected to Technical Member Grade

Bibeault, Gerald Joseph, B.S. in M.E.; Weight Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Boyd, Hugh, B.S. in Physics, Research Engineer, Goodyear Aircraft Corp.

Callaghan, Alexander John, B.S. in Ae.E.; Cadet, Engineering Officers Training School, U.S. Army Air Forces.

Center, Kenneth Warren, B.M.E.; Stress Analyst, Grumman Aircraft Engineering Corp.

Davis, James Ernest, Jr. Aero. Engineer, Naval Aircraft Factory.

Dishman, Gus Kerciel, B.S. in Ae.E.; Jr. Stress Analyst, Lockheed Aircraft Corp.

Downing, Reginald Horton, Ph.D.; Engineering Mathematician, Engineering Dept., Fleetwings, Inc.

Etkin, Bernard, B.A.Sc.; Lecturer, University of Toronto, Canada.

Gawlicki, Edward Stanley, Group Leader, Brewster Aeronautical Corp.

Guins, Sergei George, M.S. in E.M.; Instructor, New York University.

Hayes, Henry Leon, Stress Analyst, Bristol Aircraft Div., Universal Moulded Products Corp.

Linden, Jack Elmer, B.S.E.; Ensign, U.S. Navy.

Low, Lawrence Jacob, M.E.; Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Mairson, Theodore, M.S.; Research Engineer, McDonnell Aircraft Corp.

Norman, Wayne Andrew, B.S. in Arch. Eng., 2nd Lt., U.S. Army Air Forces; Jr. Engineer, Matériel Command, Wright Field.

Numbers, Martin William, Jr., B.S. in Ae.E.; Chief Liaison Engineer, Briggs Manufacturing Co.; Instructor, Wayne University.

Roe, Richard Paul, A.A.; Weight Engineer, Vultee Aircraft, Inc.

Samaras, Harry, Aero. Draftsman, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Sherman, Seymour, Ph.D.; Mathematician, Research Lab., Curtiss-Wright Corp.

Shieber, Herbert, B.S. in C.E.; Test Engineer, Airplane Div., Curtiss-Wright Corp.

Stone, Walter Norman, B.M.E.; Designer, Hamilton Standard Propellers Div., United Aircraft Corp.

Straayer, Joseph William, B.S. in Ae.E.; Structural Engineer, Dowmetal Div., Dow Chemical Co.

Unholtz, Karl, M.S. in E.E.; Research Engineer, Vega Aircraft Corp.

Transferred from Student to Technical Member

Boukidis, Peter Athanasius, M.A. in Ae.E.; Jr. Stress Analyst, Lockheed Aircraft Corp.

Brunell, Charles Howard, B.S.; Design Engineer, Goodyear Aircraft Corp.

Burkett, Zack Thomason, Jr., Draftsman, Douglas Aircraft Co., Inc.

Chikes, John Steven, Instructor, Army Div., Boeing School of Aeronautics.

Dancik, Paul J., Loftsman, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Denison, Edward Lewis, B.S. in Ae.E.; Aircraft Maintenance Supervisor, Air Service Command, War Dept.

Dooley, Joseph Brannon, Jr., B.S. in M.E.; Aviation Cadet, U.S. Army Air Forces.

Dreyer, William Nelson, B.S. in Ae.E.; Jr. Stress Analyst, Lockheed Aircraft Corp.

Duke, Isaac Monroe, Ae.E.; Stress Analyst, The Glenn L. Martin Co.

Dussel, Alex Neil, M.E.; Apprentice Engineer, Boeing Aircraft Co.

Erotas, James Thomas, B.S. in Ae.E.; Engineer, Goodyear Aircraft Corp.

Gibbs, Robert Ray, B.S. in Ae.E.; Stress Engineer, Ford Motor Co.

Goldberger, Melvin Seymour, Detail Draftsman, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Haney, Phil Penton, Engineer, Boeing Aircraft Co.

Hoffacker, Theodore, Jr., Detail Designer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Jacklitch, John James, Jr., B.S. in M.E.; Graduate Asst., Case School of Applied Science.

Jackson, Robert Lee, Jr., Ae.E.; Liaison Engineer, Douglas Aircraft Co., Inc.

Jacobson, Daniel Herman, B.S. in Ae.E.; Aero. Engineer, Goodyear Aircraft Corp.

Johnson, Ben Howard, Jr., B.S. in G.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Keppler, John Edward, B.S. in M.E.; Draftsman, The Glenn L. Martin Co.

Klauer, Leonard Warren, B.Ae.E.; Structures Engineer, Airplane Div., Curtiss-Wright Corp.

Lau, Conrad Albert, S.B. in Ae.E.; Aero. Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Levi, Charles Isadore, B.S. in G.E.; Flight Test Engineer, Aerodynamics Dept., Airplane Div., Curtiss-Wright Corp.

Lichtenstein, Jacob Herman, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Lind, Jack Raymond, B.S. in Ae.E.; Engineering Asst., Lockheed Aircraft Corp.

Lipson, Stanley, B.A.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

MacFarland, Harvey Wade, Flight Engineer in Training, American Export Airlines, Inc.

Marcmann, Donald Emmett, Aircraft Draftsman, The Glenn L. Martin Co.

Martin, Edward Trueblood, B.S. in Ae.E.; Engineering Test Pilot, Boeing Aircraft Co.

Masko, Vincent Edward, Layout Draftsman, Briggs Manufacturing Co.

Memmi, Abel, Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Migotsky, Eugene, B.S.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Monoghan, Eric J., Jr. Pilot Officer, Pan American Airways System.

Mraz, Miles James, B.S.; Contact Engineer, North American Aviation, Inc.

Nelson, Melvin Arthur, B.Sc. in Ae.E.; Stress Analyst, Boeing Aircraft of Canada Ltd.

Patak, Arthur Robert, Detail Designer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Perry, John Thomas, Jr., B.S.E.; Flight Cadet, U.S. Navy.

Pietrangeli, Gene Joseph, B.S. in Ae.E.; Jr. Aero. Engineer, Matériel Command, War Dept., Wright Field.

Pinkos, Alfons Marion, B.S. in Ae.E.; Foreman, Gibbs Boardtile Corp.

Richmond, Robert Dick, B.S. in Ae.E.; Stress Engineer, Fairchild Aircraft Ltd., Canada.

Split-thousandth Bearing Tolerances Mean Split-second Engine Performance Aloft—

Mallory Precision Bearings Provide Them!

Precision keeps pace with production in the output of Mallory Bearings through the Mallosil Process. Top-quality performance is insured by the newest and most accurate high-speed production machinery and specialized testing equipment.

Today, the Mallosil Process is applied to Mallory Bearings by skilled, intelligent Mallory workers, busy guiding the finest tools and instruments procurable to produce uniformity in bearings with tolerances measured in split-thousandths.

Good? They have to be good! Whether they carry engine loads of huge bombers or hard-hitting fighters, Mallory bearings must withstand the terrific poundings and fatigue stresses set up by seven-mile-a-minute speeds . . . and come back for more.

Mallory Bearings . . . made by Mallory's precision Mallosil Process of bonding silver to base metal backings . . . are an important step forward in bearing technique. They are indispensable in war effort; they give promise for a far-reaching future in many directions—in commercial aviation, trucks, buses, machine tools, Diesel-powered equipment, to mention a few.

Constant experimental designing and testing are solving many problems arising from the quest for better performance and the demands of changed requirements. We shall be glad to discuss the possibilities of the Mallosil Process with you.

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA • Cable Address—PELMALLO

Trademarks Reg. U. S. Pat. Off.—Mallosil, Rectostarter, Vibrapack

P. R. MALLORY & CO. Inc.
MALLORY

SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, THE MALLOSIL PROCESS—BEARINGS, SPECIAL ALLOYS, ELECTRICAL CONTACTS, VIBRATORS, VIBRAPACKS, CONDENSERS, ROTARY AND PUSH BUTTON SWITCHES, ELECTRONIC EQUIPMENT, COMMUNICATIONS HARDWARE, RECTOSTARTERS

Robb, Alexander Forbes, B.A.E.; Apprentice Engineer, Grumman Aircraft Engineering Corp.

Rocco, Robert Francis, B.S. in Ae.E.; Chief Aero. Engineer, Bisch-Rocco Amust Co.

Rohrbach, Carl, Aero. Engineer, Hamilton Standard Propellers Div., United Aircraft Corp.

Ruskin, Alfred Marshall, B.S. in Ae.E.; Jr. Aircraft Maintenance Supervisor, Air Service Command, War Dept.

Sager, Robert Charles, B.S. in Ae.E.; Aerodynamicist, Bell Aircraft Corp.

Samuel, Leonid, B.S. in Ae.E.; Designer, Apex Tool & Die Engineering Corp.

Schuette, Evan Henry, B.S. in C.E.; Assoc. Civil Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Shea, James Andrew, B.S. in M.E.; Service Engineer, Sperry Gyroscope Co., Inc.

Shevell, Richard Shepard, A.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Snyder, Norman.

Soloway, Maurice David, Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Swanson, Eugene, B.S. in Ae.E.; Instructor, Aeronautical University, Inc.

Tint, Robert S., B.S. in Ae.E.; Stress Analyst, Fleetwings, Inc.

Wasilkowski, Narcyz Mieczyslaw, B.S. in Ae.E.; Weight Control Engineer, Ford Willow Run Bomber Plant.

Wassell, Ralph Lowell, M.A. in M.E.; Major, U.S. Army Air Forces; Asst. Chief, Installation Unit, Power Plant Lab., Wright Field.

Weber, Louis Jacob, B.S. in Ae.E.; Structural Engineer, Fisher Memphis Aircraft.

Whitehead, Belleville, Jr., B.S.; Engineer, Boeing Aircraft Co.

Whitman, George Stockbridge, B.S. in Ae.E.; Jr. Engineer, The Glenn L. Martin-Nebraska Co.

Williams, Oscar Kubli, Specifications Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Wohl, Charles J., B.Ae.E.; Liaison Engineer, Airplane Div., Curtiss-Wright Corp.

Wright, Joseph Commodore, B.S. in Ae.E.; Engineering Loftsman, Goodyear Aircraft Corp.

Wulff, Roy Arthur, Stress Analyst, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Yelderman, George Robert, B.S. in M.E.; Student Engineer, General Electric Co.

Elected to Affiliate Grade

Chang, Carlos Rene, Casey Jones School of Aeronautics.

Claisse, Ricardo Raimundo, Casey Jones School of Aeronautics.

Conovaloff, John John, Inspector, Douglas Aircraft Co., Inc.

Cook, Walter L., Drawing Change Investigator, Boeing Aircraft Co.

Cortés, Lucio Melgar, Casey Jones School of Aeronautics.

Dessin, Charles H., Jr., Detail Draftsman, Kellett Autogiro Corp.

Foster, John, Jr., B.S. in Business Adm.; Asst. Editor *Aviation*, McGraw-Hill Publishing Co., Inc.

Gerin, Francisco Luis, Casey Jones School of Aeronautics.

Horowitz, David, Stress Analyst, York Aircraft Co.

Horwood, Edgar M., B.S. in M.E.; Instructor, Engineering Drawing & Mechanics Dept., Georgia School of Technology.

Marceca, Eleazar, Casey Jones School of Aeronautics.

Nicholson, Ronald H., Student, Curtiss-Wright Technical Institute.

Pierce, Jack Charles, Draftsman, The Glenn L. Martin Co.

Sfreddo, Facundo Luis, Casey Jones School of Aeronautics.

Terán, Alberto Quiroga, Casey Jones School of Aeronautics.

Vásconez, Luis Fernando, Casey Jones School of Aeronautics.

Valencia, Augusto, Casey Jones School of Aeronautics.

Walker, Frank Robert, Publisher, Commercial Aviation & Aircraft Production, Canada.

Wengryn, Michael, Draftsman, Pioneer Instrument Div., Bendix Aviation Corp.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Electronic and Radio Engineers; Mechanical Engineers familiar with design of small precision equipment, shop practice and tools; **Engineers** familiar with the design of components for electronic equipment; **Technical Men** able to write technical material for instruction books. These positions can be permanent for the right men. Engineers with experience are preferred but applicants, male or female, do not need experience if they have ability to learn and the required aptitude. Salary is open and depends only upon ability and experience. Persons already engaged in war work cannot be considered. Write directly to Chief Engineer, Bendix Radio Division, Baltimore, Maryland, giving complete details of education and experience.

Aeronautical Engineers with over two years' production experience on metal and plywood planes wanted by old established Mid-Western manufacturer. Excellent opportunity exists for aggressive, intelligent men in the postwar program of the company. Salaries $3,600 to $6,000 a year. Address inquiries to Box 178, Institute of the Aeronautical Sciences.

Analytical Chemists for supervisory and routine work in Engineering Department of large East Coast aircraft-engine company. Previous experience desirable but not required. Applications are not solicited from persons already employed in war work. Address inquiries to Box 177, Institute of the Aeronautical Sciences.

Chief Checker, must know the Army & Navy Drafting Room Manual, Standards, etc., very thoroughly; background of design achievement in the aircraft field, preferably aircraft accessories. Must be a U.S. Citizen. **Tool Drawing Checker,** on jigs and fixtures for instrument work; some shop experience desirable. **Engineer,** with electrical and mechanical design experience; instrument background; electronic knowledge desirable. **Laboratory Chief,** charge of testing and routine calibration; excellent background in physics, instrument, electrical engineering. Write or apply personally, Personnel Department, Simmonds Aerocessories, Inc., 21-10 49th Avenue, Long Island City, New York.

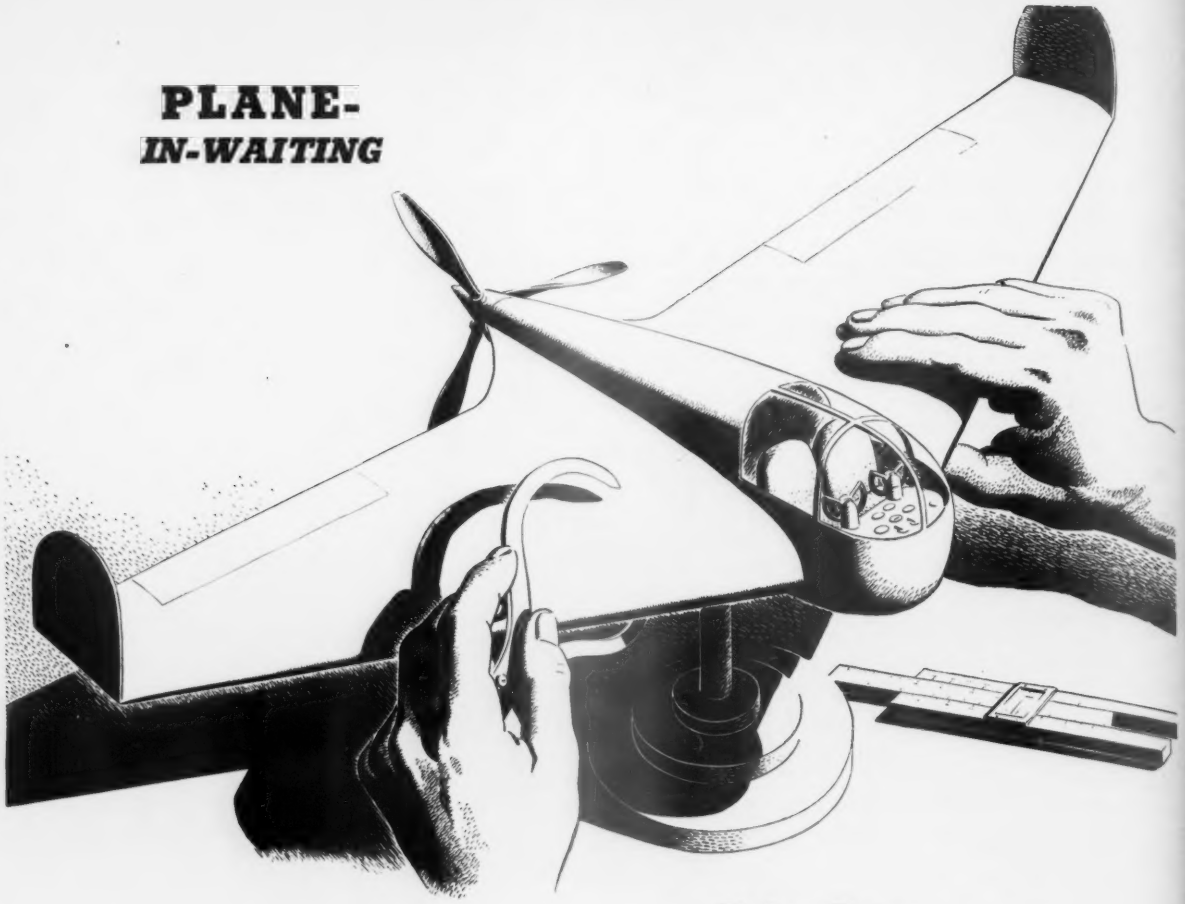
Engineering Instructors wanted by approved school in Midwest. Furnish qualifications, experience and snapshot in first letter. Address inquiries to Box 152, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer with several years of diversified experience, including wind-tunnel testing, stress, and structural design, desires position as instructor in a university. Address inquiries to Box 179, Institute of the Aeronautical Sciences.

Structures Project Engineer, M.I.T. graduate, with seven years' experience in the design and stress analysis of large airplanes, desires position with medium-sized progressive company with postwar plans. Familiar with Army and Navy requirements. Qualified to handle complete design of metal or plywood airplanes to C.A.A., Army or Navy specifications. Address inquiries to Box 180, Institute of the Aeronautical Sciences.

PLANE-
IN-WAITING



Delco-Remy
Aircraft Electrical Equipment

Today, it is in the back of some designer's mind as he works on problems of bomb-load, fire-power and combat maneuverability. In the days that follow Victory, it will take shape as a light plane produced in quantity to meet the civilian needs of men now serving in the air forces. ¶ The convenience and dependability of Delco-Remy starting, lighting and ignition will be a feature of tomorrow's private planes, while larger Delco-Remy electrical units, now built to meet the requirements of medium and heavy bombers, will serve on commercial planes. More than half of Delco-Remy's facilities are engaged in the manufacture of precision aircraft parts, electrical units and other products for the aviation industry.

DELCO-REMY

DIVISION, GENERAL MOTORS CORPORATION